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JAPAN AND CHINA AT PEACE

THE CONSTRUCTION PROGRAM OF THE MINISTRY OF RAILWAYS

By Y. S. CHUN

THE POTENTIAL EARNING POWER OF THE CHINESE GOVERNMENT RAILWAYS

DR. J. A. L. WADDELL'S MEMOIRS

Vol. XXV April, 1929 No. 4

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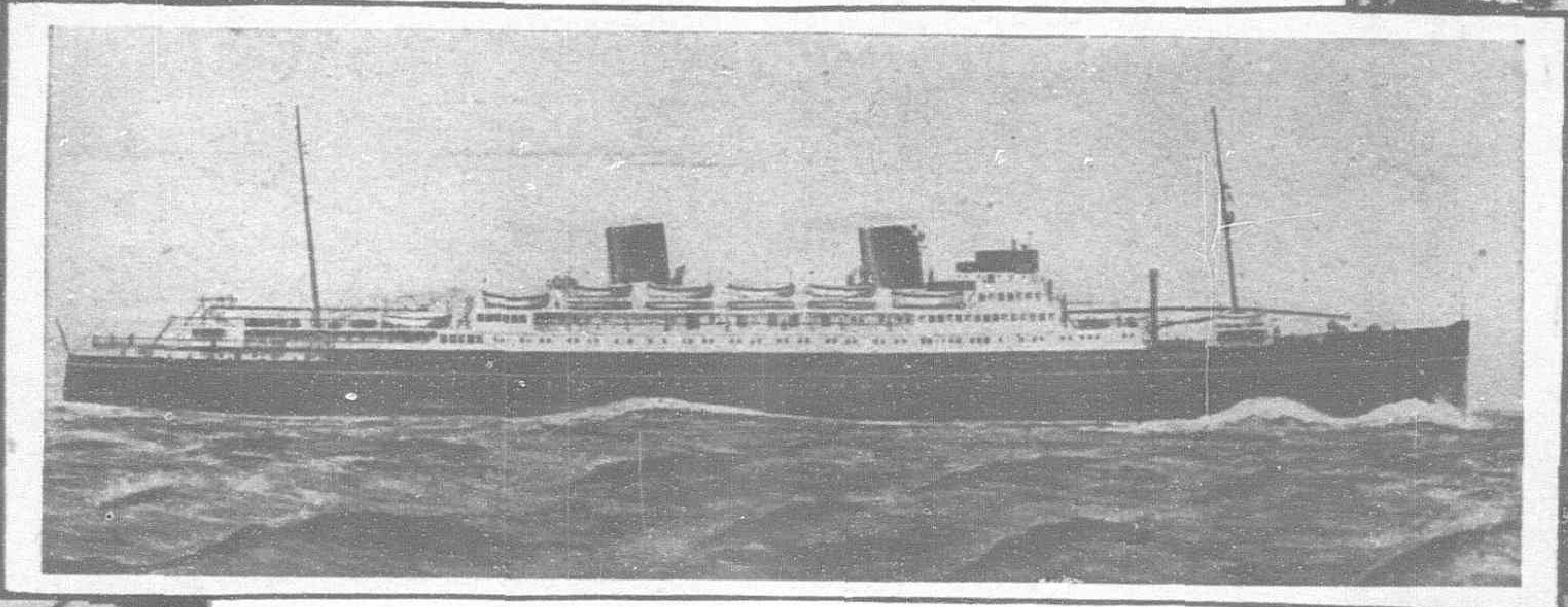

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Japan and China at Peace

Agreement Reached Over Tsinan; Japanese Troops Will Be Withdrawn from Shantung

By George E. Sokolsky

THE Tsinan Incident affords a curious instance of the endless impediments to unification and stability which have beset China since the Taiping Rebellion. Something always seems to go wrong. Some phase of each problem lacks that specific attention which alone can assure absolute success.

Thus on May 3, 1928, when General Chiang Kai-shek was leading Nanking's forces to Peking, some of his troops came in contact with Japanese troops in Tsinanfu, who were there to protect the lives and properties of Japanese subjects in Shantung. The region from Tsingtao to Tsinan has been developed by Japanese to a greater extent than any other area, except Manchuria. At one time, during and immediately after the war the Japanese were in possession of this region as heirs to the Germans, who had occupied it as an act of imperialism.

Whether the Japanese were justified in sending a body of troops to Tsinan during the period of the Northern Expedition will always be a moot question, the Chinese always contending that such military visitations are impairments of national sovereignty; the foreigners holding that until China can guarantee the protection of life and property, each Power must look after its own citizens and subjects as the United States does in Nicuragua and Haiti. This problem can only be solved when China is so thoroughly organized that the imperiling of the lives of foreigners in this country is an impossibility.

After May 3, an area of 20 *li* on either side of the Shantung railway was declared a Japanese Railway Zone into which no Chinese troops could enter. This included a part of the Tientsin-Pukow Railway, which was then divided into three parts, that south of the zone, that in the zone and that north of the zone. Through traffic between Nanking and Peking on the Tientsin-Pukow Line became an impossibility, although the blowing up of the Yellow River Bridge by Northern troops had something to do with the problem.

Dr. C. T. Wang and Mr. Yoshizawa

The Chinese immediately demanded Japan's withdrawal of troops from this region and the surrender of the railway. Japan demanded guarantees that Japanese subjects would be adequately protected. The Chinese retaliated by a boycott, which was particularly strong in such places as Shanghai, Hankow and Canton. There has been considerable discussion with regard to the effectiveness of this boycott. My own information, gathered in Japan, during a visit there during the Autumn of 1928 indicated that the boycott was not seriously afflicting Japanese industry from the standpoint of Japan's total national economy. This evidence and conclusion was attacked by Chinese and foreign writers who contended that my figures were inadequate because they did not consider the fact that the Japanese warehouses in Shanghai were being filled with goods which could not be sold because of the Boycott. The validity of this contention, however, connot be contested until the full statistics for 1928 and 1929 are available, for they alone can show whether the goods so stored were consumed. *In "Japan To-day and To-morrow,"* an authoritative publication the following data is given:

> The foreign trade of Japan for 1928 will be an improvement on that of the preceding year if the results of the first semester, *viz*: from January to June, are any criterion. The excess of imports was considerably less in value during that period. The value of the foreign trade of the whole Empire during this semester consisted of Y.974,803,000 worth of exports and Y.1,281,382,000 worth of imports, a total of Y.2,256,185,000, and an excess of imports amounting to Y.306,579,000. This import excess is Y.65,320,000 less than that recorded during the same period in the preced-

ing year. The following survey of the conditions and figures governing such improvement will serve to illustrate the extent of the upward trend.

The first table gives the figures for Japan proper, and the second those for the Colonies.

EXPORTS (FROM JANUARY TO JUNE)

	1928	1927
	(Unit, Yen 1,000)	
Provisions	72,871	+15,998
a. Unfinished Goods	19,811	+ 1,954
b. Manufactured Goods	53,060	+14,044
Unfinished Goods	40,311	+ 4,779
Prepared Goods	376,893	—37,863
Metal Goods	403,251	+18,504
Miscellaneous Articles	16,485	+ 3,666
Total	910,011	+ 5,084
Re-exported Goods	33,292	—10,845
Total Exports	943,303	— 5,761

IMPORTS

	1928	1927
Provisions	174,106	—31,709
a. Unfinished Goods	125,824	—27,419
b. Finished Manufactured Goods ..	48,282	— 4,280
Unfinished Goods	647,079	—67,375
Prepared Goods	192,031	+16,828
Metal Goods	158,042	+15,344
Miscellaneous Articles	6,859	— 140
Total	1,178,117	—67,052
Re-imported Goods	1,310	+ 173
Total Imports	1,179,427	—66,879
Grand total of Exports and Imports ..	2,122,750	—72,640
Excess of Imports	236,124	—61,118

Before 1928 a declining tendency was noticed in exports and imports, but it looks as though this tendency has been overcome, judging by the increase recorded in the first semester of that year. Especially noteworthy is the marked increase in the volume of trade during the first half of the semester, from January to March. The export trade for February increased by Y.25,500,000, and that for March also increased by Y.15,500,000 as compared with 1927.

Prominent among the staple commodities accountable for this increase were raw silk and silk fabric, the exports of which increased by Y.12,170,000, and Y.4,380,000 respectively. Since April, however, this tendency has been subject to frequent alteration due to the situation in China.

On the whole, however, trade developed favorably, the 13 ports in Japan proper recording Y.160,000,000 worth of exports and Y.158,000,000 worth of imports during July, a Y.2,000,000 export excess in the beginning of the second semester. In August, the general condition of foreign trade was unchanged, and by the latter part of the same month both exports and imports had increased conspicuously. Although the amount of raw cotton imported increased markedly, this was more than made up for by the rapid increase in exports, which were greatly stimulated by the low exchange rate.

As a result, the volume of trade shows an increase of Y.6,900,000 in exports, and Y.13,000,000 in imports as compared with the preceding year. Also, the 1928 August trade surpassed the July trade by Y.35,000,000 in exports and reduced the excess of imports during the eight months since January to Y.158,990,000, or Y.42,700,000 less than during the same period of the preceding year.

It is difficult to explain the increase in 1928 over 1927, except on the basis that either the China trade is not as important to Japan as the Chinese believe, for the United States takes about 45 per cent. Japan's foreign trade or the Chinese boycott was ineffective. Again, this is a statistical and not a political question, which can only be reviewed in the year following when all doubt would be removed. For instance, if Japan's 1929 trade with China indicated a decisive decrease, it would prove conclusively that the boycott was effective, but if 1929 showed an increase, then the warehouse storage explanation would prove unfounded.

There is a further factor in this situation which is wilfully or stupidly misunderstood by foreign propagandists in the service of China. They assume that because the Sino-Japanese trade is at the moment unfruitful, Japan no longer is interested in the potentialities of this trade. They seem to believe that if my impressions are true, then Japan must no longer seek a commercial market in China, which is sheer nonsense. The fact is that boycotts, civil wars, disturbances, marching armies have so disrupted this market that it has ceased to be of immediate primary importance and that Japan has been forced to seek elsewhere to sell her surplus commodities. But should China be at peace, should the markets of the interior be opened, then Japan, as well as other commercial nations, are bound to benefit thereby.

Dr. C. T. Wang and Mr. Yoshizawa are to be congratulated on effecting an end to the bitterness. It will take time before Sino-Japanese relations are as cordial as they should be and it can only be hoped that no foreigners of other nationalities will intervene to foment strife where there should be friendship.

The documents in the agreement follow:

Declaration by Japan and China

While looking upon the incident which occurred at Tsinanfu on the 3rd of May last as one most unfortunate and even tragic in view of the traditional friendship between Japan and China, the two Governments, mindful of the keen desire entertained by the Government and people on both sides for the advancement of their mutual good relationship, hereby declare themselves ready to dismiss entirely from their minds all discordant feelings attending the incident in the expectation that their future relationship may thereby be greatly improved.

Note from Mr. Yoshizawa to Dr. C. T. Wang

28th March, 1929.

Monsieur le Ministre,

I have the honor to notify Your Excellency that should the Chinese Government guaranty on their sole responsibility the safety of the lives and property of the Japanese subjects resident in China after the withdrawal of the Japanese troops from Shantung, the Japanese Government would be prepared to withdraw all their troops now in Shantung in two months from the date of the signing of the documents concerning the settlement of the present affair.

I beg to propose at the same time that both governments should respectively appoint Commissioners who shall in conference on the spot make such arrangements as may be necessary in connection with the withdrawal of the Japanese troops.

Accept, Monsieur le Ministre, etc.

Note from Dr. C. T. Wang to Mr. Yoshizawa

28th March, 1929.

Excellency,

I have the honor to acknowledge the receipt of Your Excellency's note of even date notifying me that should the Chinese Government guaranty on their sole responsibility the safety of the lives and property of the Japanese subjects resident in China after the withdrawal of the Japanese troops from Shantung, the Japanese Government would be prepared to withdraw all their troops now in Shantung in two months from the date of the signing of the documents concerning the settlement of the present affair, and proposing at the same time that both governments should respectively appoint commissioners who shall in conference on the spot make such arrangements as may be necessary in connection with the withdrawal of the Japanese troops.

I beg to state in reply that the Chinese Government, as early declared, would on their responsibility and in accordance with international law afford protection to foreign nationals in China, and that they consider it naturally incumbent on them to extend such protection to resident Japanese in the future.

I beg further to acknowledge your notification regarding the date on which the withdrawal of troops shall begin and the period in which it shall be completed and also to express agreement to your suggestion that commissioners shall be appointed on both sides who shall in conference on the spot make the necessary arrangements in connection with the withdrawal of the Japanese troops.

Accept, Excellency, etc.

Protocol as to damages

With regard to the damages incurred by Japan and China through the occurrence of the Tsinanfu incident on the 3rd of May last, it is hereby agreed that a joint commission shall be formed of equal number of members appointed on both sides which shall determine these damages through investigation on the spot.

The Construction Program of the Ministry of Railways

By Y. S. Chun, Director of the Department of Planning and Construction

IN Dr. Sun Yat Sen's economic program, railway construction is put foremost of all other undertakings. Some of our readers may still remember that he resigned from the presidency in favor of Yuan Shi-kai to take up the post of Director General of the national Railway Corporation in 1912. In his late years of intense activities, he did not neglect to give to Kuomintang a comprehensive economic program, in the "The International Development of China." The National Government is now endeavoring to carry out this most important part of his program through the Ministry of Railways.

The Ministry of Railways was duly inaugurated with Mr. Sun Fo as Minister, and began functioning November 1, 1928. Just before taking up the portfolio, Mr. Sun Fo submitted his proposal of the *Principles of Reconstruction* to the Central Political Council. It was passed at the 162nd. session of the Council and handed over to the National Government for execution. It called for, *inter alia* the construction of 20,000 miles of railway in the course of ten years, or an average of 2,000 miles every year.

Early this year the next step was taken when Minister Sun Fo submitted to the State Council his railway construction program with financing schemes based on the return of certain Boxer indemnities and the expected increase of Customs revenue from the new tariff. This construction program contains four groups of lines arranged in the order of their construction is as follows:

Sun Fo, Minister of Railway

The Proposed Construction Program

Group 1.—	Shiuchow-Chuchow Section, Canton-Hankow Line	270	miles
	Tungkwan-Lanchow Section, Lung-Hai Line	657	,,
	Tsangchow-Shihchiachuang Line	138	,,
Group 2.—	Nanking-Changsha Line	615	,,
	Nanking-Canton Line	1,212	,,
	Shiuchow-Nanchang Line	503	,,
	Foochow-Nanchang Line	523	,,
	Canton-Yunnan Line	1,313	,,
	Changsha-Yunnan Line	1,100	,,
Group 3.—	Paotou-Ningsha Line	344	,,
	Chengtu-Chungking Line	324	,,
	Taokow-Tsinan Line	182	,,
	Tatung-Puchow Line	510	,,
Group 4.—	Paoching-Chinchow Line	751	,,

N. B.—In Group 2, The Shiuchow-Nanchang and Foochow-Nanchang Lines together constitute an alternative to the Nanking-Canton Line, and the Changsha-Yunnan and Paoching-Chinchow Lines of Group 5, an alternative to the Canton-Yunnan Line.

The above lines total between 5,378 and 6,103 miles depending on the choice between the alternative lines, and the construction cost is estimated to vary from $751,521,000 to $863,329,000. To supply a portion of the estimated cost so as to enable the work of construction to start as soon as possible, two kinds of railway construction bonds were proposed, one to be secured on the returned Boxer indemnities of Russia, Italy and Great Britain and the other on the increase of Customs revenue from the new tariff enforced February 2, 1929. Their chief points of interest may be seen from the following table:

National Government Railway Construction Bonds

Kind	Security	Face Value	Term	Interest
1	Boxer Indemnity	$135,000,000	18 years	7%
2	Customs	$300,000,000	25 years	7%

It is expected that in six years' time from the first issue of the above bonds, the actual proceeds from their sale, together with the indemnity remittances up to the end of 1928, will amount to $408,500,000, which sum will be sufficient for the construction of about 2,500 miles of railway.

The above program was brought up at the Central Political Council, which referred it to three Committees for examination: one headed by Mr. Li Shih-tseng to report on the indemnity bond scheme, one headed by Mr. T. V. Soong on the Customs bond scheme, and one headed by Marshal Feng Yu-hsiang on the construction program. The Third Committee finished their deliberations on February 6, and the program as amended by them and adopted by the council is as follows:

Authorized Construction Program

Group 1.—	1.	Shiuchow-Chuchow Section, Canton-Hankow Line	270	miles
	2.	Tungkwan-Lanchow Section, Lung-Hai Line	657	,,
	3.	Tsangchow-Shihchiachuang Line	138	,,
Group 2.—	4.	Nanking-Changsha Line	615	,,
	5.	Changsha-Yunnan Line	1,100	,,
	6.	Paoching-Chinchow Line	751	,,
	7.	Tatung-Puchow Line	510	,,
Group 3.—	8.	Paotou-Ningshia Line	344	,,
	9.	Chengtu-Chungking Line	324	,,
	10.	Taokow-Tsinan Line	182	,,

	11. Shiuchow-Nanchang Line	503 miles
	12. Foochow-Nanchang Line	523 ,,
Group 4.—	13. Nanking-Canton Line	1,212 ,,
	14. Canton-Yunnan Line	1,313 ,,
	15. Chungking-Liuchow Line	

Function of the Projected Lines

The Shiuchow-Chuchow Section (No. 1 on the program) is to supply the missing link of the Canton-Hankow Line, which together with the Peiping-Hankow is a trunk line extending north and south through the heart of the country. It will enable the coal output of Hunan to reach southern industrial centers. The Tungkwan-Lanchow (2) and the Paotou-Ningsha Lines (3) are extensions of the Lung-Hai and the Peiping-Suiyuan lines respectively, serving to encourage colonization of China's great Northwest. The Tsangchow-Shihchiachuang Lines (3) will facilitate the exportation of the famous Shansi coal. The Nanking-Changsha Line (4) will provide an outlet for Pinghsiang and Pohloh coal, and with the Changsha-Yunnan Line (5) form a trunk line joining the southwestern provinces to the capital. The Nanking-Canton and the Canton-Yunnan Lines (13 and 14) constitute another such line following a more roundabout route *via* the coastal provinces, which are more advanced than the rest in commercial and industrial development. The Paoching-Chinchow Line (6) is a complementary line to the Changsha-Yunnan leading to the southern sea-port, and in conjunction with the Chengtu-Chungking (9) and the Chungking-Liuchow Lines (15) taps the products of China's largest province—Szechuen. The Tatung-Puchow Lines will give Shansi Province its main artery of transportation and make it practicable to move its coal toward the west. The Chengtu-Chungking Line besides functioning in the way mentioned is to serve as the start of the Hankow-Szechuen Line, the completion of which is to be deferred to a later construction program. In the meantime, this line will give Szechuen easier access to its most important river port. The Taokow-Tsinan Line (10) will provide an outlet to the East for the anthracite coal of Honan. The Shiuchow-Nanchang and the Foochow-Nanchang Lines (11 and 12) will supply the need of better interconnection between the central and southern provinces.

The Question of Finance

Messrs. Li Shih-tseng and T. V. Soong have not yet reported to the Central Political Council on the indemnity and Customs bonds. But the future of railway construction was assured on March 24, 1929, when the Third National Congress accepted in principle the Central Political Council's *Proposal to Appropriate Definite Funds for Economic Reconstruction during the period of Political Tutelage.* This proposal which may be considered as a further step toward realizing Dr. Sun's program is summarized as follows:

1.—One half of all the revenue of the country to be appropriated for economic reconstruction.

2.—One half of the revenue of the Central Government to constitute the National Reconstruction Fund, which will be employed by the government in developing railways, highways and other means of communication; coal, iron and other key industries; conservancy, irrigation and reclamation work; colonization of undeveloped parts of the country.

3.—One half of the provincial revenues to constitute Provincial Reconstruction Funds, which are to be employed by the provincial governments in developing provincial highways and other means of communication; city improvements; conservancy, irrigation and colonization of undeveloped parts of the provinces; improvement of agriculture.

4.—For the next five years, one half of the National Reconstruction Fund is to be applied to railway construction, and one half of the provincial funds to the improvement of agriculture, the rest to be apportioned among the other undertakings mentioned

5.—A Supreme Economic Council will be established in the National Government to centralize planning of economic reconstruction; membership of the council to include experts from the party and those from the foremost of their profession in the world.

The proportion of revenue to be devoted to reconstruction, and of this the part to be employed for railway construction have been accepted as standard by the Congress, but the actual amount will, of course, depend upon the national budget.

Work Being Done on Projected Lines

The Tungkwan-Lanchow Section of the Lung-Hai Line has already been making steady progress westward from Tungkwan with Sian as the immediate goal. The work is in the charge of the engineering staff of the Line.

Construction of the Shiuchow-Chuchow Section of the Canton-Hankow Line is entrusted to Mr. S. S. Chuck, who has been appointed chief engineer. Graduated at Stanford University, Mr. Chuck has a brilliant record extending over almost twenty years. For a long time he had an engineering and construction business in Hankow, and lately he has been in charge of the highway department of Kwangtung Provincial Government. At present he is inspecting the line with Mr. Weir, Assistant to Dr. J. D. L. Waddell, Consulting Engineer to the Ministry of Railways, prior to starting the work of construction.

Reconnaissance survey has already started on the Nanking-Canton Line with two parties on the field. One with F. K. Sah in charge will survey the northern part of the line from Yenping to Nanking including the Foochow-Yenping and the Hangchow-Changshan branches. The other headed by H. A. Panhoe will survey the southern part from Yenping to Canton, including two branches also, the Amoy-Lungyen and the Swatow-Meihsien. Mr. Sah is well known as chief engineer of the Kiaochow-Tsinan Line, from which he has been "loaned" to the Ministry of Railways for the duration of the survey. Ever since his graduation from Purdue University in 1910, he has been constantly in railway service. Starting as student engineer in the southern section of the Canton-Hankow Railway, he next worked as district engineer in the I-Kwei section of the Hankow-Szechuen Railway, and as chief engineer of the Ku-Pi railway, a private line in Yunnan. Then he was commissioned by the Ministry of Communications to survey the Tsangchow-Shihchiachuang Line. During the Kiaochow rendition parley, he was on the expert commission for the appraisal of the Shantung Railway, which he subsequently joined in his present capacity. Mr. Panhoe graduated from University of Illinois in 1913. He had extensive railway experience including survey of the Chuchow-Chinchow Railway. Before joining the Ministry of Railways he has been the Commissioner of Public Works for Canton Municipality and is responsible for the fine road-building in that city.

Two more parties are in the process of organization for the reconnaissance survey of the Changsha-Yunnan and the Canton-Yunnan Lines, and before long will be out in the field.

Economic and Geological Surveys

In the past, engineers who make reconnaissance survey of projected lines, also gather information on the agricultural, mineral and other products of the territories traversed, from which estimates of probable revenues were made. The Ministry of Railways have introduced a plan whereby this work is entrusted to special survey parties, one to make economic investigations in general and the other to make geological surveys along the lines.

Economic investigation will be made by a party of three on each line. Detailed information is to be obtained at first hand, as far as possible, not only of the nature and quantity of products and imported goods, but also of the existing facilites of transportation, and the economic function of the line projected. Sixteen men with college training have been assigned to this work, and are now undergoing one month's intensive training: every morning in the Ministry of Railways, and every afternoon in the Agricultural college of National Central University, where special courses have been arranged for them on such subjects as crops, forestry, agronomy, vegetables, etc. Toward the end of this month, they will be out in four parties on as many different lines.

Geological survey of the lines is not only important from the economical point of view on account of the mineral resources that may be opened up, but also from the scientific points of view, because very little is known of the geology of the territory concerned, *viz.* the southern and southwestern provinces where surveys will now be made. A special arrangement has been made by the

Ministry of Railways with W. H. Wong, director of the National Geological Survey, for the sending out of a number of competent specialists, and with Dr. V. K. Ting, a well known authority on geology, for organizing a party.

The National Geological Survey is one of the oldest scientific institutions operated by the government, having been founded more than twenty years ago mainly through the efforts of Dr. V. K. Ting. It has concluded extensive surveys, mainly in North China, and made detailed studies of coal fields in North Manchuria and Shantung, and of earthquakes in Shensi and Yunnan. Its reports and publications have been noteworthy contributions to science, and its staff under the leadership of Dr. Wong is a group of able and enthusiastic men prominent in their profession. Some of them have already been sent out on the new lines : H. S. Wang and C. Y. Li to the Nanking-Canton Line and H. C. Tan and S. W. Wang to the Nanchang-Shiuchow Line. A third party is being organized with Mr. C. C. Liu in charge, assisted by Mr. T. F. Hou and Mr. C. C. Tien, to work along the Changsha-Yunnan Line up to Kweiyang. The rest of the line will be surveyed by another party which is now working in Shensi and is proceeding to Kweiyang *via* Szechuen. Dr. V. K. Ting himself, as mentioned already, will join the party when it reaches Szechuen.

The Potential Earning Power of Chinese Government Railways

IN view of the need of better communications facilities for the proper development of China, many schemes have been suggested to extend the existing railway lines. It is interesting therefore to study the past performances of the railways in order to arrive at some approximation of their potential earning power.

Table I. gives the financial results of operation for the years 1915-1925. It can be seen that the average percentage of increase of operating revenue per kilometre of line operated, was between 6 per cent. and 8 per cent., and that even with the partial interruption of railway operation during the years 1924-1925 owing to civil disturbances the average increase, for the entire period was 5.5 per cent. In 1925, the total operating revenue was $120,000,000 or $17,800 per kilometre of main and branch line operated. It is therefore safe to assume that under the present state of development, the existing railways can earn at least $16,500 per kilometre in 1930.

There are at present about 8,000 kilometres of main and branch line and about 3,000 kilometres of loops, sidings and industrial tracks. This length of line should therefore earn a gross operating revenue of $132,000,000 in 1930. This amount should increase by at least 5.5 per cent. from year to year, until the gross operating revenue per kilometre of line reaches the amount of $35,000. Under efficient management, there is no reason why this amount cannot be reached. The Peiping-Liaoning, formerly the Peiping-Mukden Line had a gross operating revenue per kilometre of line of $32,686 in 1922, $39,360 in 1923, $37,684 in 1924 and $32,995 in 1925. Lines like the Peiping-Hankow the Tientsin-Pukow, the Shanghai-Nanking, the Lung-Hai, the Shantung Railways and in fact more than 80 per cent. of the total length of Government Railways operate through territories similar to that traversed by the Peiping-Liaoning line and serve as connecting links between the many commercial centers along their line. An operating revenue of $35,000 per kilometre of line is therefore not unattainable in the course of fifteen to twenty years.

Table I. also shows that the net earnings varies from 43.69 per cent. of the gross revenue in 1925 to 58.80 per cent. in 1919. The average for the years 1916-1920, which were more or less normal years, was 54.98 per cent. and the average for the years 1921-1925, the period when military operations interfered with railway operation to a great extent, was 46.24 per cent. It is therefore a conservative estimate to assume that from 1930 to 1934, the net earnings of the railways will be 45 per cent. of the gross revenue, from 1935 to 1939, 50 per cent. and from 1940 to 1945, 55 per cent.

TABLE I. FINANCIAL RESULTS OF OPERATION, 1915-1925.

Year	Operating Revenue				Operating Expenses	Operating Ratio	Net Income and Net Profit & Loss Credits or Debits (Excluding interest charges)	Net Earnings	Per Cent. Net Earnings to Total Operating Revenue
	Amount	Progressive yearly increase percentage since 1915	Per km. of line						
			Amount	Progressive yearly percentage since 1915					
	$	%	$	%	$		$	$	%
1915	55,860,513	—	10,477	—	29,514,862	53	Cr. 104,710	26,450,360	47.35
1916	62,671,720	12.35	11,425	9.05	28,842,278	46	Dr. 375,193	33,544,249	53.45
1917	63,873,704	6.93	11,713	5.73	30,040,565	47	Dr. 2,487,566	31,345,573	49.07
1918	77,652,153	11.60	14,195	10.65	34,322,615	44	Cr. 469,635	43,799,173	56.40
1919	82,848,906	10.36	13,884	7.29	38,270,946	46	Cr. 4,140,940	48,718,900	58.80
1920	91,284,221	10.32	15,257	7.81	42,594,035	47	Cr. 3,490,153	52,180,339	57.16
1921	96,450,836	9.53	15,674	6.94	53,967,045	56	Cr. 3,189,746	45,673,537	47.35
1922	96,393,388	8.11	15,854	6.10	55,276,082	57	Cr. 1,473,906	42,591,212	44.18
1923	115,719,619	9.53	17,653	6.74	63,091,359	55	Cr. 3,659,742	56,288,002	48.64
1924	114,383,422	8.29	16,844	5.42	65,605,203	57	Cr. 5,366,129	54,144,348	47.34
1925	119,989,815	7.95	17,818	5.45	68,350,891	57	Cr. 783,350	52,422,274	43.69

The figures and amounts for any year in this table relate only to those railways that submitted their reports for that year. The revenues and expenses of railways still under construction are also excluded from the amounts shown.

Net Earnings = Operating Revenue—Operating Expenses.

$$\left.\begin{array}{r}+\text{Net Income Cr.}\\ \text{or}-\text{Net Income Dr.}\end{array}\right\}\begin{array}{l}+\text{Profits.}\\ -\text{Losses.}\end{array}$$

The following table shows the probable earnings of the existing railways for the years 1930-1945 as estimated according to the results of past experience shown in Table I. The gross revenue for 1930 is assumed to be $16,500 per kilometre of line, so that the total gross revenue of the 8,000 kilometres of existing line will be $132,000,000. For the first five years it is assumed that gross revenue will increase at the rate of 5.5 per cent. yearly, while for the rest of the period the rate of increase is taken at 5 per cent. At these rates, the gross revenue will reach the amount of $35,127 per kilometre of line in 1945, an amount already shown to be well within the limits of possibility. The net earnings for the first five years is estimated at 45 per cent. of the gross revenue and increases from $59,000,000 in 1930 to $73,000,000 in 1934. For the next five years it is estimated at 50 per cent .of the gross revenue and reaches the amount of $105,000,000 in 1939. For the rest of the period it is estimated at 55 per cent. and reaches the amount of $155,000,000 in 1945. After 1945, it is evident from the table that even taking gross operating revenue as stationary from year to year, the net earnings of the existing railways will exceed $160,000,000 per year.

There can be no doubt that under normal conditions, the future results of operation will exceed the results of the past upon which the estimates in Table II. are based. The years 1915-1925 have seen many disturbances that rather retarded the growth of the railways. With the return to normalcy and with the abolition of likin and the advent of tariff autonomy, trade and industry will surely develop and the railway will share in that development to a great extent. For these reasons, it is very evident that the figures given in the following table rather underestimate the earning power of the railways.

TABLE II.—ESTIMATED NET EARNINGS OF EXISTING RAILWAYS, 1930-1945.

Year	Operating Revenue			% Net Earnings to Total Operating Revenue	Net Earnings
	% Increase over prev. year	Amount	Per Km. of main & branch line		
	%	$	$	%	$
1930 ..	—	132,000,000	16,500	45	59,400,000
1931 ..	5.5	139,260,000	17,407	45	62,667,000
1932 ..	5.5	146,919,300	18,365	45	66,113,685
1933 ..	5.5	154,999,861	19,375	45	69,749,937
1934 ..	5.5	163,524,853	20,440	45	73,586,183
1935 ..	5.5	172,518,719	21,565	50	86,259,359
1936 ..	5.0	181,144,654	22,643	50	90,572,327
1937 ..	5.0	190,201,886	23,775	50	95,100,943
1938 ..	5.0	199,711,980	24,964	50	99,855,990
1939 ..	5.0	209,697,579	26,212	50	104,848,789
1940 ..	5.0	220,182,457	27,522	55	121,100,351
1941 ..	5.0	231,191,579	28,889	55	127,155,368
1942 ..	5.0	242,751,157	30,344	55	133,513,136
1943 ..	5.0	254,888,714	31,861	55	140,188,792
1944 ..	5.0	267,633,149	33,454	55	147,198,231
1945 ..	5.0	281,014,806	35,127	55	154,558,143

Some Thoughts Concerning Economics in the Development of China

By Dr. J. A. L. Waddell

[This is the first of a series of memoirs which Dr. J. A. L. Waddell has prepared for the Ministry of Railways and which will be published in the " Far Eastern Review "]

I. Introduction and Fundamental Ideas

HAVING lately been retained as Advisory Engineer to the Ministry of Railways of the National Government of China, and being a bit of a crank on " Matters Economic," whilst traveling from America to this country I conceived the idea of writing a series of short papers on economic subjects, both technical and otherwise, for publication in English and Chinese in the leading newspapers and periodicals throughout the land. At my first conference with His Excellency Sun Fo, Minister of Railways, I broached this idea to him. He immediately gave it his hearty endorsement, especially as I had suggested that each paper, as soon as written, should be submitted to the Ministry for approval or modification before its publication. Later, I made an arrangement with Dr. P. C. Hsieh, Secretary to the Minister of Railways at Nanking, to send him all of the papers under consideration to be approved, translated, and distributed to the press.

Altogether, I have listed nearly a score of topics for treatment. Some of them being technical will not be included in this series, but will be given to one or more of the engineering societies. Probably I shall not find time to cover all the topics during my stay in China, because they are to be prepared out of office hours, and because my official duties are both heavy and extensive, requiring for their satisfactory fulfilment many hours per day.

It is not my intention to try to cover any subject at all exhaustively, but simply to set the intelligentsia of China to thinking on some matters that are fundamentally important for the development and betterment of their great country.

It is urgent that the people of China not only study carefully and thoroughly the principles of economics and political economy, but also that they bring them into practice in their daily lives. Especially is this true in technical work; for most of the developments needed here involve engineering. Unfortunately, engineering economics is a subject that has not yet been effectively treated in print. The literature thereon is not only meager but scattered and hard to find. There are a few theoretical books that are very good, but of practical treatises there are only three or four, one being Wellington's " Economic Theory of Railway Location" and the other my " Economics of Bridgework." Reference to economic problems is occasionally made, more or less at length, in editorials, memoirs, and communications in the technical press.

In my opinion, China is destined, before the expiration of another century, to become one of the most advanced, prosperous, and powerful nations of the world; for she has the population, the mental ability, the patience, and the willingness to work that are requisite for the attainment of these *desiderata*. All that she needs to-day to become thus successful is a well considered and properly directed effort, combined with a thorough and far reaching policy governing all important details in the lives of her people and her dealings with other nations. To attain the acme of national success it will be necessary to develop a spirit of true patriotism and individual unselfishness among the youth of China, and to educate the masses so that eventually everybody will be able to read, write and cipher.

It will also be essential, of course, to provide higher education in all lines of endeavor for those who are specially gifted mentally, as these must be the future leaders in the peaceful economic struggle which China will have to wage with a large portion of the rest of the world. Such a struggle is inevitable and must be anticipated and prepared for. The best evidence of the correctness of this statement is China's history during the last two or three centuries; for most of the leading nations of the world have oppressed her and interfered with her economic progress. It is not unnatural for other nations to look with uneasiness upon the ultimate rise of China to power in world affairs; but an obstructive policy on their part would be illogical and unwise, for every nation which treats her in a really friendly spirit, and not solely and unsympathetically as a business rival, would gain greatly by the interchange of commodities and in many other ways. For several decades China will have to purchase machinery and materials abroad on a large scale; and naturally she will prefer to deal with those countries that treat her in a just and equitable manner.

In speaking of the future development of China and of her extrication from the troubles with which she is now so heavily afflicted, mainly because of her late seven-years' war, many people are ultra-pessimistic, claiming that it will take several generations to overcome existing evils and to put the country on a sound, economic basis. To persons who make such remarks to me, I deny the validity of their pessimism and point out the great things that Japan has accomplished in not much more than half a century; for in that time she has dropped her ancient civilization and has adopted instead that of the Occidental nations. The changes of conditions that she has effected in that comparatively short period of time are enormous, fundamental, and radical. In general education of the masses she leads the world; in the Russo-Japanese war her medical staff was the most efficient ever known up to that time; her railroads (although, unfortunately, narrow-gauge) are models of excellence; her cities and towns are brilliantly lighted by electricity developed from her numerous nearby waterfalls; her highways are extensive, well built, and well maintained; her communities (big and little) are provided with excellent potable water and in many cases with sewerage; her postal system is hardly susceptible of improvement; and her harbors are a credit to the engineering profession.

All this being true, and the present status of China being about on a par with that of Japan a few decades ago, would it not be well for Chinese engineers to study carefully the history of Japan during the last five or six decades and learn how the engineers of that country effected the wonderful progress that is indicated by the existing conditions of development throughout the Japanese empire?

Possibly, in thus holding up the doings of the Japanese people as an example for the Chinese to follow, I shall render myself unpopular in this country; for I recognize that at present there is very little love lost between these two Oriental nations. However, speaking concerning the engineers of Japan, a goodly number of whom, all old and dear friends of mine, entertained my party at luncheon whilst we were passing through that country some four weeks ago, I would state that they hold a very kindly feeling towards China, that they wish the National Government good luck in its praiseworthy endeavor to rehabilitate the country, and that they stand ready at any time to aid their brother engineers of China to the best of their ability, if called upon so to do.

Knowing both nations intimately as I do, and having a deep affection for them both, it grieves me to see any discord between them. Ultimately, I trust, they will let bygones be bygones, and will work together upon a truly friendly basis on the task of placing China in her proper position amongst the great nations of the world. If these two Oriental peoples were to join forces and work together in harmony, there is no limit to the important things they could accomplish; and the power of the combination would eventually be great enough to dominate the globe. It is not only my ardent wish but also my firm conviction that, within a generation or two, these two great nations will come together and work hand in hand for their joint interest without any thought of either aggression or resentment over past disagreements on the part of either, having in view the placing of the combination in the lead in world politics, in the advancement of science, and in the physical and mental betterment of humanity as a whole. If I may be so bold, I would like to put the statement before you in the form of a prophecy, so that at some time in the distant future, long after both you people of China whom I am now addressing and I shall have passed to the beyond, credit will be given me for having had the quality of "vision"—a possession that is of the utmost importance to an engineer or to anyone upon whom falls the performing of important tasks.

Just here it might be well for me to make a plain and candid statement of the relations of the Japanese and the Chinese on the one hand and myself on the other, in order that, when you read the succeeding memoirs that I contemplate writing, you will not do so with a lurking suspicion in your minds to the effect that I am at all influenced by Japanese interests in the advice which I am giving you.

In 1882 I was called to Tokyo by the Japanese Government to occupy the chair of Civil Engineering in the Imperial University at that city. I found there a number of highly intelligent young men in the engineering classes, but a curriculum that was laid out mainly on theoretical lines. This I immediately proceeded to change by introducing into it, to the greatest extent possible, courses in practical engineering, given by both book instruction and fieldwork. The change proved acceptable to both the students and the University authorities, and I gradually enlarged the practical features of the curriculum during the four years of my sojourn in the Land of the Rising Sun. It was there that I wrote my first two books, the first, published in America, being "The Designing of Ordinary Iron Highway Bridges," and the second "A System of Iron Railroad Bridges for Japan." The latter was specially written for and published by the Japanese Government as one of a series of memoirs that were being issued from time to time on various subjects by the University.

After my return to America, where I opened in Kansas City, Missouri, an office as Consulting Engineer, I was followed there, at first by my old students and afterwards by other graduate Japanese engineers, all of whom worked for a while (generally from two to four or even five years) in my office and in the offices of other engineers with whom I placed them, or in field or shops, where I was often successful in locating them. Some Japanese came to me solely for the purpose of securing introductions to prominent persons or companies in the United States; and to these I gave letters of introduction—often directed to people whom I did not know personally. As far as I have learned not one of these letters was ever ignored by the recipient—which goes to show that Americans have a kindly feeling for the people of the Orient and a real desire to be of service to them.

For some thirty-five years I thus trained many of the young engineers of Japan, at first in Kansas City and afterwards in my New York City office; but of late they have almost ceased coming to me. I have now only one Japanese in my employ.

During forty years I thus served Japan faithfully and well, always devoting to her interests the best that was in me—for the first four years under salary and thereafter as a matter of love and affection and not as a mere duty. I have constantly been imparting to her young men what I have learned in my long professional career, often directly but mainly through the technical treatises that I have written, which books are widely used by the engineers of Japan.

My days of direct service to that country are past, and her young men no longer need my aid in their professional advancement. The Japanese engineers have learned about all that I know, and now are able to travel alone in the engineering world. This is truly a great satisfaction to me—one one of the greatest of my entire professional career; for success is not to be measured by the amount of money accumulated but by that of service rendered.

As just indicated, my professional connection with Japan for several years has been ended, but there remains a firm and enduring friendship between the Japanese and myself that nothing can break. This is evidenced by the fact that they have shown and continue to show in various ways their appreciation of my service. In 1888 the Great Emperor conferred upon me the Order of the Rising Sun with the rank of Knight Commander in recognition of my four years' service as a professor and of the value of the book I had written for the University Memoirs; in 1915 the University made me "Hakushi," the highest honor in its gift; and in 1921, whilst I was in Tokyo after completing my first service for China, the present Emperor, then Prince Regent, bestowed on me the Second Class Order of the Sacred Treasure as a recognition of my usefulness to Japan in the training of so many of her engineers who now are at or near the head of the profession in their country.

Again, on every possible occasion, I am entertained and highly honored by my old friends, who thus and in speech make evident the kindly feeling that they and the engineering profession of Japan in general entertain towards me. Truly, the Japanese are a grateful people; and it is no wonder that I love and appreciate them so highly—but that fact does not militate against my serving the Chinese Government and the Chinese people just as devotedly and effectively as I have served Japan.

Early in 1921 I was called to Peking by the Chinese Government to serve as a member of the International Jury of Award in relation to the competition for the building of a new bridge over the Yellow River on the Kin-Han (now the Han-Ping) Railway, and later as Consulting Engineer on several large and important projects. My stay in China was limited to about six months; and I made in that time a number of warm friends there—engineers and others. In addition to my regular duties I gave, all told, twenty lectures to engineering societies, engineering students, railway men, and the Y.M.C.A. Without unduly flattering myself, I have come to the conclusion that my efforts in China's interests must have been appreciated; for not only did my Chinese friends tell me so, but also the Peking Government conferred on me the Second Class Order of China Ho. The most conclusive proof thereof, however, is the fact that the new National Government has called me to China to serve as Technical Advisor to the Ministry of Railways. In my new official capacity I shall do my utmost to be of real service to the Ministry; and, outside of working hours, I shall do what I can to advance the interests of the country in technical, educational, and economic lines.

In offering these memoirs on economic subjects, I by no means claim to be an authority on "political economy," although generally recognized as one on "engineering economics;" nevertheless, no observing and thinking man who has reached the age of seventy-five years and has traveled a great deal can fail to acquire some notions of his own on matters in the line of political economy; and it is with such matters that I expect to deal in certain of the memoirs of this proposed series.

II.—Economics of Transportation for China

Transportation for China may be divided into four primary groups, listed in the order of their importance as follows:

A. Water
B. Railway
C. Highway
D. Aerial

Waterways are more important than either railways or highways in that they are Nature's means of communication and because they cost generally but little for upkeep. They have also the economic advantage that steamboats carry more freight than railroads per unit of fuel expended. On the other hand, the streams, lakes, and harbors in the northern portions of the country freeze in winter and thus block entirely transportation over them by boats. For this reason in cold districts it would not do to rely upon them solely; hence it would be necessary to supplement them by railways or highways or, preferably, both.

Railways and waterways should be made to supplement each other; and they should not be considered as rivals, for the latter should carry the bulky freight in places where they compete, leaving for the railroads the transportation of most of the passengers, light and perishable freight, express, and mail.

Where rivers freeze, the bulky freight, such as grain, with proper prevision can generally be shipped by water between harvest time and the date when the waterways become ice-bound; and that date in many important locations can be postponed somewhat by the employment of ice-breakers for keeping the channels and harbors open.

In America, where people are always in a hurry for everything, river and canal navigation has not received the attention that its importance deserves; but the government there is beginning to awaken to a knowledge of the economic value of water carriage, for the construction of several great waterways is now being seriously contemplated.

In China, on the contrary, the waterways have always been the principal means of travel and freight transportation; and immense sums of money have, very properly, been spent on bank protection and the building of canals.

I said at the outset that railways and waterways should not be considered as rivals; but there is one place where they cannot help being such, *viz.*, where they cross each other without tunneling. In America the river-transportation interests often either oppose strenuously and proposed crossing of an important waterway by a bridge, or make such demands concerning its layout as to render its construction almost prohibitory. The railroads, on the other hand, feel that they, too, have some rights; and they fight for them vigorously. The arbiter in such disputes is the U. S. Engineer Corps, an organization of the War Department. It apparently has a tendency to favor the waterways side of disputes, perhaps because the maintenance of waterways is one of its regular duties. The consequence is that the railway companies and the promoters of toll-bridges, or the communities where highway bridges are needed, are forced to pay for their structures more than they can well afford—sometimes they are even prevented entirely from building. There is a happy mean, of course; and it should invariably be adopted by the arbiter when settling disputes concerning such river or harbor crossings. The bridge should not be allowed to interfere seriously with navigation, block prejudicially the passage of the water, or affect adversely the regimen of the stream by causing scour of banks or shifting of the navigable channel. But arbitrary or unjust demands on the part of the shipping interests should be ignored, not only in the interests of justice but also because they militate against national progress.

This question of river crossings by railways and highways will arise some day in China, hence it is pertinent to discuss here the possible *pros* and *cons* of both sides of the controversy. The navigation interests may demand tunneling, as that method of crossing does not interfere with them at all; but as tunneling is almost always more expensive than bridging, the railway people would object strenuously and the highway authorities even more vigorously. Not only is a tunnel expensive to build, but sometimes it is costly to maintain; and it is always disagreeable to its users, who do not care to go below ground any sooner than Nature compels them to.

If the navigation interests do not demand a tunnel, they may insist upon a high-level bridge and one with an unreasonably long span or long spans. Both the owners and the users of the structure would object to this, first, because of the large initial cost, and, second, because of the high climb, which would involve both loss of time and much expense.

The railway or highway people, as the case may be, will generally offer a low level bridge with as short spans as they think the deciding authority will accept; and the navigation interests will probably fight this proposal "from the word go"—possibly with good reason. They will say that the proposed structure would be a menace to navigation on account of the restricted channel and the danger of a vessel that is out of control running into a span and seriously damaging both itself and the structure. There is a good deal of sense in this claim, but it is not of enough importance to warrant compulsion of the railway or highway to climb to an abnormal height. The best compromise is to adhere to a low-level structure having its vertical clearance sufficiently great to permit small river craft to go beneath the fixed spans, and giving enough height at the movable span to pass, without any possibility of interference, the tallest-masted vessels that navigate the waters to be traversed by the structure. The spans should be long enough to avoid undue interference with the current and injurious scouring of the river banks.

When the building of lorries (generally called motor-trucks int he U.S.A.) and motor-busses was started in North America there was conficit initiated between their owners and those of the railroads they paralleled. In self defence the latter sometimes inaugurated bus lines and motor-truck lines of their own. To-day, however, it is pretty generally recognized that such lines make good feeders for the railways; bug they should run transversely to them and not parallel. For China it would be best to build a few long railroads as main arteries of travel with an occasional cross line of railroad where some distant place of importance is to be reached, and have a sufficient number of highway feeders on each side of the railway to carry the exports and imports of the entire district that the line is intended to serve. It must be remembered that in China railroads are expensive and that macadamized highways are comparatively cheap; hence the latter should be built as feeders to the former, instead of branch lines of railroad.

In respect to the economics of railway operation in China, much might be said as to details, but space will not permit, hence my following remarks will be confined to the major problems thereof.

A. Shipping in bulk instead of in small parcels or packages is truly economic; and the railroad management should teach its patrons this axiom. Charges on car-load lots can be made considerably lower than those on small-bulk shipments and still leave a good margin of profit.

B. Return freight should be sought so as to avoid the hauling of empty cars, which practice, on the face of it, is uneconomic.

C. To as great an extent as feasible, trains should be made up of cars destined for the same station, so as to avoid loss of time and money in switching. When coal or ore is shipped over the line there should be trains of cars loaded solely with these freights.

D. High speed of trains, although augmenting the fuel consumption and the wear and tear of rolling stock, will save so much in time as to make it economic; but, of course, for each kind of train there is one rate of speed that is more economic than any other, and the management should endeavor to adopt it on all occasions. The economic speed is a function of the quality of the fuel; and an investigation should be made on the economics of the various kinds of coal available.

E. A weak bridge, imperfect track, or any other condition that necessitates the placing of a slow order for trains is uneconomic, in that it increases the time of travel between termini. The cost of operating trains is an inverse function of their average speed (including stops); consequently anything that tends to reduce the number or to shorten the lengths of stops, or to prevent the slowing up of trains is conducive to economy.

F. A well maintained track is economic, because it not only permits of high speed but also reduces the wear and tear on the rolling stock.

G. Proper up-keep of locomotives and cars is economic, for the reason that breakdowns thereof cause delays—and delays cost money.

H. A good *Esprit de Corps* and a fine spirit of loyalty among the railroad employees are conducive to economy, because they militate for increased efficiency and effort, and, consequently, for augmented output and reduced expense.

I. Idleness of employees or any waste of their time is uneconomic. Whenever they run short of useful occupation, the management is at fault and should be brought to task.

As for the economics of the building, operation, and maintenance of highways in China, it may be said that, for the present, it would not be economic to adopt any road surfacing that is more expensive than macadam. Of course, concrete or bitulithic pavement would be better, but just now it is beyond the means of this country. The grading can be done inexpensively on account of the cheapness of Chinese labor. Cuts should be avoided, unless so doing would increase the grade beyond the desired limit. The roadbed should be thoroughly rolled with a heavy road roller operated by mechanical power, and the layers of earth when placed in embankments should be limited to about six inches in thickness. The macadam surfacing should be not less than ten (referably twelve) inches thick, and it should be constructed according to first class specifications—such as those given on page 1837 of my "Bridge Engineering." The width of the macadamized surface should be twenty feet for two lines of vehicles, with ten feet more for each extra line provided for. The drainage, which is the most important feature of either road or railroad building, should receive the utmost consideration and care. This matter is of such extreme importance that one of the memoirs of this series will be devoted entirely to its discussion.

The limiting load for any truck, including its own weight, for a macadamized road in China should be five, or at the very most, six American short tons. No narrow-tired vehicle, excepting only jinrikishas for carrying passengers, should be allowed on the finished road. Of course, up to a certain reasonable limit, the greater the carrying capacity of a motor-truck the greater the economy of operation; but this presupposes a truly hard-surfaced road. When the wheel load becomes so heavy as to break up the macadam surface or to force it into the supporting soil, the damage done will over-balance the economy of the greater capacity of vehicles.

The same remark applies also, but in a lesser degree, to autobuses. If these are provided with amply wide tires, the question of their load being too great for the road surface is not likely to arise.

As for the economics of the different kinds of power for highways, I would list them thus:

A. Mechanical power
B. Animal power
C. Man power

For other places than modern highways, I would list the methods of carriage, from the economic viewpoint, as follows:

A. Horse-drawn
B. Camels
C. Pack horses
D. Jinrikishas
E. Man-pulled carts
F. Wheelbarrows
G. Sedan chairs and dandies
H. Freight-poles for two or more men
I. Back loads for men

On waterways the methods of carriage, arranged in the order of their economics, will generally be found to be as follows:

A. Large steamers
B. Small steamers
C. Motor launches
D. Sailing junks
E. Small boats operated by rowing, poling, or dragging

There is some doubt about the correctness of the position on this list of Item C; for it is conceivable that under unfavorable conditions, the sailing junks or the small boats operated by man power might be more economic in freight carrying than motor launches; but when the latter are large and when there is an ample depth of water to float them, they certainly are superior.

There is a feature of economics in both construction and operation that must not be forgotten, *viz.*, that what may be cheapest for the contractor or the operator may not be best for the nation, because the great mass of the people must be kept employed and fed, even if figures show that such employment is uneconomic. But this point will be treated in a future memoir entitled "Economics of Labor for China."

At first it is probable that the newly constructed highways would be used by horse-drawn wagons and carts, pack animals, jinrikishas, man-pulled acrts, sedan chairs, dandies, pole-carriers, and pedestrians; but the slow-moving wheelbarrows with their heavy loads and comparatively narrow tires should not be allowed upon it, nor should any other narrow-tired vehicles except passenger-carrying jinrikishas. Sooner or later the pack animals and pedestrians (including those carrying sedan chairs, dandies, and poles) would be compelled to use paths adjacent to the road, built along the berms, and the slow-moving carts and, eventually, even the jinrikishas would be displaced by lorries and motor-buses, either for economic reasons or by governmental edict. The proper place for these, and some of the other crude conveyances of freight, to function is the cheap side roads of the country districts that would be needed as feeders for the main highways and their branches.

As for aerial transportation, the time when it will be most needed is the next decade, so as to carry mail, express, and occasional passengers to distant points all over the country. After the railroads and highways in any district are in full operation, there will be no such crying need for airplane transportation as there is to-day, hence most of the planes could be moved to more remote districts, leaving only a few for extra-rapid travel of mail and for policing the country.

A well thought out system of aerial transportation should be installed without delay; for not only would it serve the purposes just mentioned, but also it would enable the Government to quell uprisings and to preserve peace and order throughout the Republic.

Book Notes

A Sound History of the Far East

"THE FAR EAST" by Payson J. Treat, NEW YORK, HARPER & CO.

The Far East has suffered more from propagandists than any other part of the world. In European America, the international propagandist was a product of the Great War—his services were required to keep nations allied and to keep other nation's at daggers' points. But largely, the scholarly mind devoted itself to a discussion of historical and economic problems and dealt with them on the basis that the facts of each situation cannot and must not be suppressed or distorted.

The Far East, however, has rarely been discussed from the aloof standpoint of scholarship. Instead, propagandists boosted one country or poured vials of hatred upon another. Numerous methods have been devised to keep journalists, publicists and authors "sweet," so that so many volumes bear the earmarks of inspiration. As one reads, one feels that the author has an ax to grind: he is either pro-Chinese, pro-Japanese, pro-Russian, pro-British, pro-Philippine independence or he is anti this, that and the other country.

When one edits an organ of mildly sagacious opinion, inspiration of this nature creates no confusion in the readers' mind, for the bias of the editor is visible on all occasions, similarly, when a correspondent accepts subsidies or gifts or merely supports his personal friends because they are his friends, his sins find him out through his day by day twist of the news. But somehow, the printed book, the bound volume is taken more seriously and therefore damage is done when the author fails to present his facts with photographic accuracy.

Now, Professor Treat has written a sound history. It is pro-nothing; it is anti-nothing. It presents the facts, clearly, realistically and without nationalistic inspiration. It is the same type of book as the average history of the United States, used in a college in America, would be. Professor Treat makes no attempt to convince his readers that Russia is bad and Great Britain good; that Japan is aggressive and China suffering from unjust disregard for her righteousness. He is not a moralist but an historian. He preaches no sermon, but has written a history. Such a book is rare and is well worth reading because it gives the reader an opportunity to refresh his memory, to weigh in the balance the tendentious outpourings of the propagandists.

Professor Treat's idea of considering the Far East as a unit is original and affords the reader a new perspective—for these countries do somehow hang together. It is only natural that a summary, as this book must be, cannot give the intricate details of all that occurs—but no one wants the details, except the expert and often he requires a bird's-eye view to show him the relationship of each detail to the whole problem. Professor Treat's history provides just such a view.

G.E.S.

General Survey of Economic Situation in August, 1928

Difficulty of Writing a Trade Report on China

The following Interesting Article is Taken from "Commercial, Industrial and Economic Situation in China" by H. H. Fox, C.M.G.

THE compiler of this report is faced with a dilemma. He is tempted to give an account of the stirring events that have taken place since the last report was written in June, 1927—the fighting between north and south which long ebbed and flowed in such mysterious fashion but which seems to have culminated for the time being in the peaceful occupation of Peking by the Nationalist forces in the early days of June, 1928; the series of events which led up to the timely despatch of the Shanghai Defence Force in the spring of 1927; the nation-wide reaction against Communism causing the rout of the Bolshevik agents in China, and the emergence of a Government which, for the first time since the Revolution in 1911, may fairly claim to represent China as a whole, presaging a new era in the relations of China with foreign powers—all these are matters of absorbing interest to the student of history but are not perhaps of any practical importance to the business man for whose benefit this report is written. What chiefly concerns him is what effect has all this fighting had on China as a market for foreign and in particular British goods—how has it affected the purchasing power of the people and the credit of Chinese firms and financial institutions—what progress is China making as an industrial nation and to what extent are Chinese goods competing with British—all pertinent questions to which a report on commercial and economic conditions in perhaps any other country but China might reasonably be expected to supply an answer. But China is not like other countries in respect to reliable sources of information on commercial and economic subjects. The detailed statements regarding the nation's finances which are published at regular intervals by the Governments of Europe, America and Japan, the volumes of statistics showing the direction of the nation's foreign trade and the progress of her industrial development, the periodical reports of the great railway administrations, shipping and other industrial companies, the financial reviews of the great banks—all the data on which the foreign observer relies to assist him in forming an opinion on the commercial and economic conditions prevailing in the country in which he is interested—are to all intents and purposes wanting in China. The last serious attempt to strike a balance of China's national revenue and expenditure was made in 1920, when the Central Government drew up a budget which a contemporary writer described as based on little more than a pious hope that revenue and expenditure would correspond with the estimates. No accounts of the operating expenses and income accounts of Chinese railways have been published since 1924—during the last two years Chinese railways have practically ceased to count as a factor in the country's transport problems. No accounts worthy of the name are published by Chinese industrial enterprises, such as cotton mills, coal mines, &c.; and the same remark applies to Chinese banks and commercial companies in general. The only reliable sources of information open to the inquirer into trade conditions in China are the quarterly and annual reports and returns of trade published by the Chinese Maritime Customs and the series of bulletins and journals issued by the Chinese Government Bureau of Economic Information in Peking. The former have for the past 50 years provided a constant stream of valuable information regarding the foreign trade of China as far as it comes within the cognizance of the customs administration, and one may safely say that without the customs returns no report on the trade of China would be possible. The publications of the latter represent a most praiseworthy attempt on the part of a comparatively young and not very well supported Government department to provide "economic, commercial, industrial and financial information regarding the Republic of China," but this information, having regard to the vast area covered and the absence of statistics above referred to, lacks co-ordination and cohesion so that its value to the compiler of a report of this kind is limited by the time at his disposal in piecing together, as in the laying of tesselated pavement in some vast building, the numberless and varied items of information the bulletins contain.

In any attempt therefore to present a picture of economic and commercial conditions in China at a given date, one is forced to rely to a very great extent on the customs returns, information supplied by local merchants and one's own observation. As regards the customs returns, which have been described as the barometer of China's commercial progress, a word of warning is necessary. The almost uninterrupted growth of China's import and export trade as shown in the returns during the past five years, in spite of the varied disabilities which that trade has suffered, has been the subject of much comment, and well informed observers have not hesitated to say that after all things are not so bad as they are painted and that perhaps the sorely tried British merchant is a little inclined to make mountains of mole hills. But careful scrutiny of the returns will show that they cannot be accepted as an entirely accurate barometer of the state of China's foreign trade, and in saying this I desire to cast no reflection whatever on the very efficient Statistical Department of the Maritime Customs. China is such a vast country that a falling off of revenue or trade in, say, the southern ports, is more than compensated for by increased returns from the northern ports. In 1927, for instance, figures for the foreign trade of Shanghai and the Yangtze ports show an all round decrease as compared with 1926, which is largely compensated for by the increased trade done at Tientsin, Dairen, Tsingtau, Antung and other northern ports. Again a low rate of exchange tends to inflate the import figures, while taxation and heavy transport charges go to enhance the export values. The general increases in values of the imports for customs purposes as the result of recent revision of tariff values must also be taken into account, added to which the constant fluctuations in exchange make comparisons spread over a number of years very apt to be misleading; there was, for instance, a drop of nearly 3d. in the average sterling value of the tael in 1927 as compared with 1926. Again the customs returns may be swelled by abnormal imports of rice and other cereals to make up for bad crops and for famine relief. In 1923 China imported 98 million taels worth of rice, in 1925, 61 million; in 1926, 89 million; and in 1927, 107 million. *Lastly, it must be remembered that the customs figures merely indicate the quantity and values of goods imported and exported on which duty has been paid—they do not show whether or not the goods have been paid for—and it is payment not so much as orders that is the merchants' and manufacturers' chief concern.*

As regards the value to business men of commercial information, based on the writer's personal experience on the spot, there is this difficulty that in China it is almost impossible to generalize or express an opinion on any subject without immediately adding a rider or reservation, a difficulty which has become acute owing to the unsettled conditions that have prevailed during recent years. To the question is there a market in China for British goods, one hastens to reply undoubtedly there is, and a growing one—*but* one is obliged to add that, for the time being, the demand is restricted owing to the prevalence of civil war with interruption of communications with the interior, a general sense of insecurity amongst dealers and a variety of minor causes. What about China's tariff?—a flat rate of 5 per cent. *ad valorem* both on imports and exports to which has recently been added the so-called "Washington surtaxes" of 2½ per cent. on ordinary goods, and 5 per cent. on luxuries, which are not, however, collected by the customs—*but* to these duties must be added a number of extra, and as far as the treaties are concerned, illegal taxes imposed by regional authorities, which in the case of certain commodities such as oils, tobaccos, &c., bring the duties up to 30 to 40 per cent. *ad valorem.* Again the question most frequently asked of the writer by manufacturers at home is, Can one safely deal directly with Chinese firms? The answer is you can and the practice is steadily growing, *but* for various reasons (see Hints to Manufacturers above) it is a risky business only to be conducted with extreme caution.

The information supplied by British merchants in regard to the business done in the main lines of imports and exports forms perhaps the most valuable portion of these reports, and I take this opportunity of expressing my deep appreciation of the willing assistance which the leading British firms have afforded my colleagues and myself during the ten years that I have been responsible for the compilation of the annual China trade report. When, as has so often been the case in recent years, business has been bad and losses heavy, the task of sitting down and reviewing the history of the past year cannot be other than a most distasteful one for the merchant concerned, but I cannot recall a single case where a request for information has not been promptly, if not cheerfully, complied with, and one cannot help hoping that the indomitable spirit with which our merchant firms have faced their difficulties and losses during these black years will in the end meet with its deserved reward.

I shall not attempt, then, to present an exhaustive review of present day commercial and economic conditions in China, partly because of the difficulties above alluded to and partly because, unless I have entirely failed in the object I had in mind when writing this report, I feel that any intelligent person who will take the trouble to read through the report will be able to draw his own conclusions as to the present state of affairs in China and decide whether it is a country with which he can profitably do business or in which he may, with reasonable safety, invest money.

No one can live the best part of a lifetime in a country of such vast and almost unlimited possibilities as China without being an incurable optimist as to the future of the country and its people, but it must be admitted that the events of the past two years have made heavy drains on one's fund of optimism. It would indeed seem that almost every ill that trade is heir to has lately descended on this unfortunate country; civil war entailing the upkeep of enormous armies and the resulting displacement of old-established civil authority by a new and practically irresponsible military autocracy, who in the process have disorganized the country's normal course of trade and bled her commerce white; the arresting of the country's industrial development by nation-wide strikes organized with little attempt at concealment by Bolshevik emissaries from Moscow; the senseless boycotts of foreign business interests, involving as great, if not greater, damage to the Chinese themselves, by irresponsible student organizations too young and impetuous to realize that they are being made tools of by Communistic elements bent on the destruction of all law and order in the country; excessive and suicidal taxation of foreign trade by regional authorities directed chiefly against the big foreign distributing companies who have invested large sums of money in China, thereby giving profitable employment to millions of heretofore poverty-stricken Chinese, but not sparing in their greed for money China's growing export trade which they are doing their best to cripple; all these actions and tendencies makes even the most sympathetically disposed foreign observer inclined to despair of the future of this great country. Yet a ray of hope seems to lie—and here the optimist reasserts himself—in the sterling good sense of the Chinese people, especially the agricultural and merchant classes, their innate love of peace, their remarkable capacity for "carrying on" in the face of apparently insurmountable obstacles, and in particular their ability to resume "business as usual" wherever they are given even the shortest breathing space. It is pertinent to remember that in China, unlike some other Oriental countries, commerce has always been an honorable occupation in which the greatest in the land have not disdained to take a share, and I have before me, as I write, a letter from a Chinese friend, who formerly held one of the highest offices in the Chinese Government, advising me of the formation of a Chinese import and export company of which he is managing director and asking me to bring his company to the notice of British merchants "in the hope that business relations of an intimate and cordial nature will be established between them and us to the advantage and profit of both parties," a sentiment which I am sure British merchants both in China and at home will most heartily reciprocate.

Asiatic Wives of American Husbands

THE immigration and naturalization laws of the American Government have, in some respects, grown without plan. They have been passed by Congress at various times not in accordance with a definitive scheme but rather to meet current situations. The result is the curious anomoly of a disregard for the institution of marriage as an element in citizenship. American citizens marrying alien wives do not accord to their wives the benefit of American citizenship; at the same time, these women usually lose the citizenship of the lands of their nativity. They become persons without a country; travel becomes difficult because such women cannot obtain passports, and there is always a possibility of confusion and grief.

This situation is complicated by the fact that under the immigration laws, aliens may be excluded from the United States should the quotas of the countries from which they come be filled. Thus families are liable to be separated, the father and children being admitted to the United States as citizens, the wife and mother being kept out of the country, except as a short term visitor. European women coming in as immigrants, may, at the end of a year, apply for naturalization papers, but Asiatic wives of American citizens are excluded from this privilege. They may never become citizens of the United States and are therefore forever deprived of permanent residence in the land of their husband and children.

An instance of this was recently brought to our attention. An American had been resident in China for perhaps a quarter of a century. He had married a Chinese woman by whom he had several children, all of whom had been educated in the United States. He had now reached a station in life in which he was considering the possibility of retirement to a farm in California. But the question was what could he do with his wife. Neither he nor his children could consider leaving the wife and mother in China, while they enjoyed the fruits of her upbringing and care in California, yet, under the law there is no relief for her.

In the Philippines, the courts have recently decided differently. The following account is taken from the "*Manila Bulletin* :"

" The right of a Chinese resident in the Islands to bring his wife and children as long as he holds a landing certificate was upheld yesterday when Judge Block of the court of first instance granted the writ of habeas corpus sought by a Chinese named Jao Yan, legal holder of a landing certificate, to bring his wife Tee Liok Huy to the Philippines.

" A year ago, Tee Liok Huy arrived in Manila on board the *s.s. Tang Shan* from China to join her husband Jao Yan. The insular collector of customs, however, having appointed a special board of inquiry to dicuss the right of Tee Liok Huy to land in the city, refused to allow the woman to enter because the board had declared her an alien.

" Detained at the customs station for a considerable period, the woman through her husband Jao Yan, filed a writ of habeas corpus petition for her release and to allow her to stay in the Islands with her husband.

" The petition they filed alleged that the decisions of the special board of inquiry and the insular collector of customs were contrary to law ; that under the Immigration Act of 1917 and the rules and regulations issued by the secretary of labor in the same year provided that a Chinese wife of a citizen is an admissable alien.

" The decision handed down stated that inasmuch as the respondents failed to contradict the evidence of the petitioners that Yao Yan was really married to Tee Liok Huy ; that he went to China in 1920 and returned in 1925, although his landing certificate was doubted by the board, " a mere doubt or suspicion that it (the evidence) may not be true is not sufficient. It is elementary that mere suspicion, conjecture, or speculation is not evidence and should not be made basis for finding a fact in issue, or disregarding testimony, the court ruled.

" The court ordered the collector of customs to release Tee Liok Huy immediately and permit her to enter the city."

The only possible solution for this problem is by Act of Congress. Congressman Dyer, who is always a friend of the American in China, has proposed legislation, but this has not passed because there is always the possibility of marriage being used as a subterfuge for naturalization. It is now suggested that the Immigration Act of 1924, governing these questions be amended to make admissable to the United States an alien ineligible to citizenship who is the mother of an American citizen. It is further suggested that an Asiatic wife of an American citizen may be admitted to the United States provided that he has been married to an American husband for five years immediately preceding her application for admission and has resided with him during that period (except perhaps for short holidays) continuously.

This suggestion is a brilliant one as it covers every phase of the question. It protects the Asiatic wife of an American citizen, while at the same time, it prevents marriage to American citizens from being used as a subterfuge for obtaining admission into the United States for those who otherwise would be kept out.

Japan's Foreign Trade

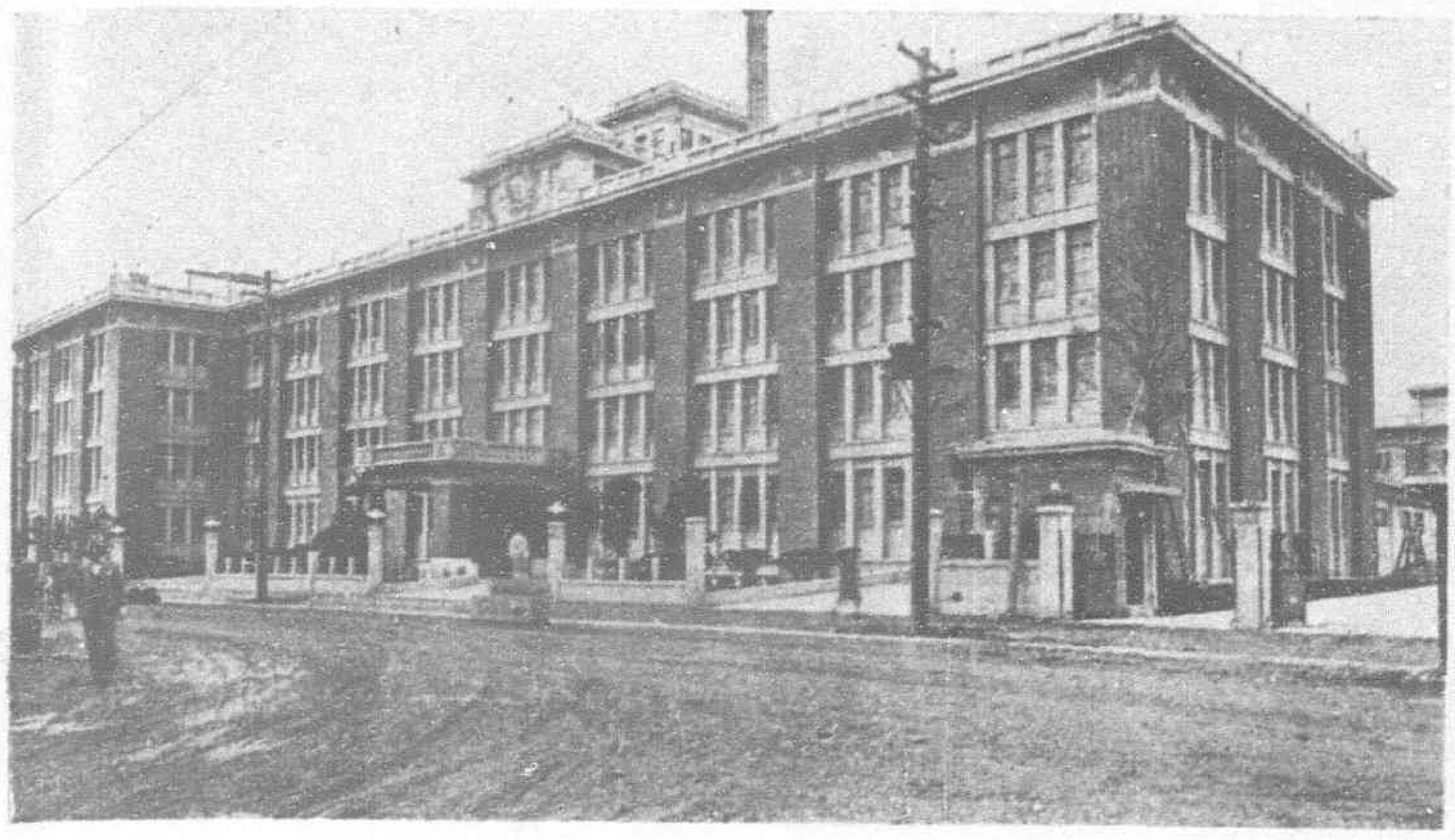
AN interesting compilation of Japan's foreign trade was recently published by the Japanese Ministry of Commerce and Industry. It would appear that from the beginning of the Meiji period until 1912 (45 years), Japan did not reach the figure of one billion yen. But since 1912, in spite of numerous difficulties, the rise has been fairly constant. The peak year was 1920, immediately after the war, but that was surpassed in 1925 because of the reconstruction of Tokyo and Yokohama after the Earthquake. 1919 and 1920 were boycott years in China, but they showed an increased volume of trade. The figures follow :—

The table given below shows the yearly import and export amounts for Japan for the last 60 years, from the first of Meiji Era to the end of last year, according to the Ministry of Commerce and Industry :

(In thousand yen)

Year	Export	Import	Total	Balance
1868	Y.15,553	Y.10,693	Y.26,246	Y.*4,860
1869	12,908	20,784	33,692	7,874
1870	14,543	33,741	48,284	19,198
1871	17,969	21,916	39,885	3,948
1872	17,026	26,174	43,201	9,148
1873	21,635	28,107	49,742	6,471
1874	19,317	23,462	42,779	4,144
1875	18,611	29,975	46,586	11,364
1876	27,712	23,964	51,676	*3,746
1877	23,348	27,420	50,769	4,072
1878	25,988	32,874	58,862	6,886
1879	28,175	32,953	61,128	4,777
1880	28,395	36,626	65,021	8,231
1881	31,058	31,191	62,250	132
1882	37,722	29,446	67,168	8,275
1883	36,268	28,444	64,712	*7,823
1884	33,871	29,672	63,544	*4,198
1885	37,146	29,356	66,503	*7,789
1886	48,876	32,168	81,044	*16,707
1887	52,407	44,304	96,711	*8,103
1888	65,797	65,859	131,657	62
1889	70,203	66,274	136,478	*3,928
1890	56,763	81,880	138,583	25,176
1891	Y.79,621	Y.63,873	Y.143,494	Y.*15,748
1892	91,199	75,982	167,181	*15,217
1893	90,434	89,430	179,865	*1,003
1894	113,708	121,754	235,463	8,045
1895	137,494	138,745	276,239	1,250
1896	119,724	180,087	299,812	60,363
1897	165,116	261,511	426,627	96,395
1898	168,240	324,760	493,000	156,519
1899	218,381	299,058	447,440	10,676
1900	209,562	313,358	522,921	103,795
1901	266,507	282,234	548,742	15,725
1902	271,276	290,837	562,114	19,560
1903	304,159	321,394	625,553	17,234
1904	329,687	371,800	701,488	42,113
1905	335,108	498,056	824,173	153,957
1906	444,324	452,369	896,693	8,044
1907	453,621	504,064	957,686	50,443
1908	399,004	447,204	846,208	48,199
1909	431,984	403,665	835,649	*28,318
1910	478,507	474,090	952,598	*4,417
1911	466,766	532,436	999,202	65,670
1912	548,365	643,992	1,192,357	95,627
1913	656,173	769,183	1,425,357	113,010
1914	613,129	610,422	1,223,552	*2,707
1915	729,438	546,276	1,274,715	*184,162
1916	1,153,187	770,537	1,923,724	*382,650
1917	1,640,709	1,053,522	2,694,231	*587,187
1918	2,021,938	1,701,384	3,723,323	*320,554
1919	2,180,447	2,225,465	4,405,912	45,018
1920	2,040,160	2,378,987	4,919,149	338,827
1921	1,308,744	1,677,206	2,985,951	368,461
1922	1,687,986	1,933,526	3,621,512	245,539
1923	1,492,550	2,017,602	3,510,153	525,051
1924	1,858,147	2,508,978	4,367,123	650,830
1925	2,354,168	2,627,936	4,982,104	273,767
1926	2,098,127	2,425,504	4,523,631	327,346
1927	1,992,302	2,179,943	4,171,345	186,741

Asterisks mark years when the country experienced an excess of exports over imports.



The Silk Conditioning House, Yokohama

Sakuragi-cho, the Principal Street of Yokohama

Reconstruction and Development of the Tokyo-Yokohama District

The following article is taken from a pamphlet of the same title by J. H. Ehlers, Engineer Trade Commissioner, Tokyo, Japan, and published by the U.S. Department of Commerce.

ON September 1, 1923, the Tokyo-Yokohama district was visited by a severe earthquake. The earth shock was much more severe in Yokohama than in Tokyo and the destruction by the quake itself more serious, but the ensuing fires in the congested areas of Tokyo made the damage there much greater and the loss of life appalling.

After the earthquake, preparations were immediately made for reconstructing the devastated districts. A Reconstruction Commission, with Premier Yamamato as president, and including Home Minister Goto and 22 other leaders of Japan, was called into being. This commission considered plans and put forth a proposal for reconstruction involving the vast sum of over Y.2,000,000,000. From time to time this project was cut down until it reached the figures as shown in this report. Afterwards the Capital Reconstruction Board, with Viscount Goto as chairman and with 11 other members, took charge of the reconstruction plans. The entire work finally was shifted to the Ministry of Home Affairs, and at present (under the direction of the Minister of Home Affairs) the chief of the Reconstruction Bureau, V. Horikiri, with 16 division chiefs handles all work in connection with the National Government's part in the reconstruction. Law No. 53, passed on December 24, 1923, provided the working plan for the new city planning work. Imperial Decree No. 49, dated March 15, 1924, provided for the execution of this plan.

Scope of Reconstruction

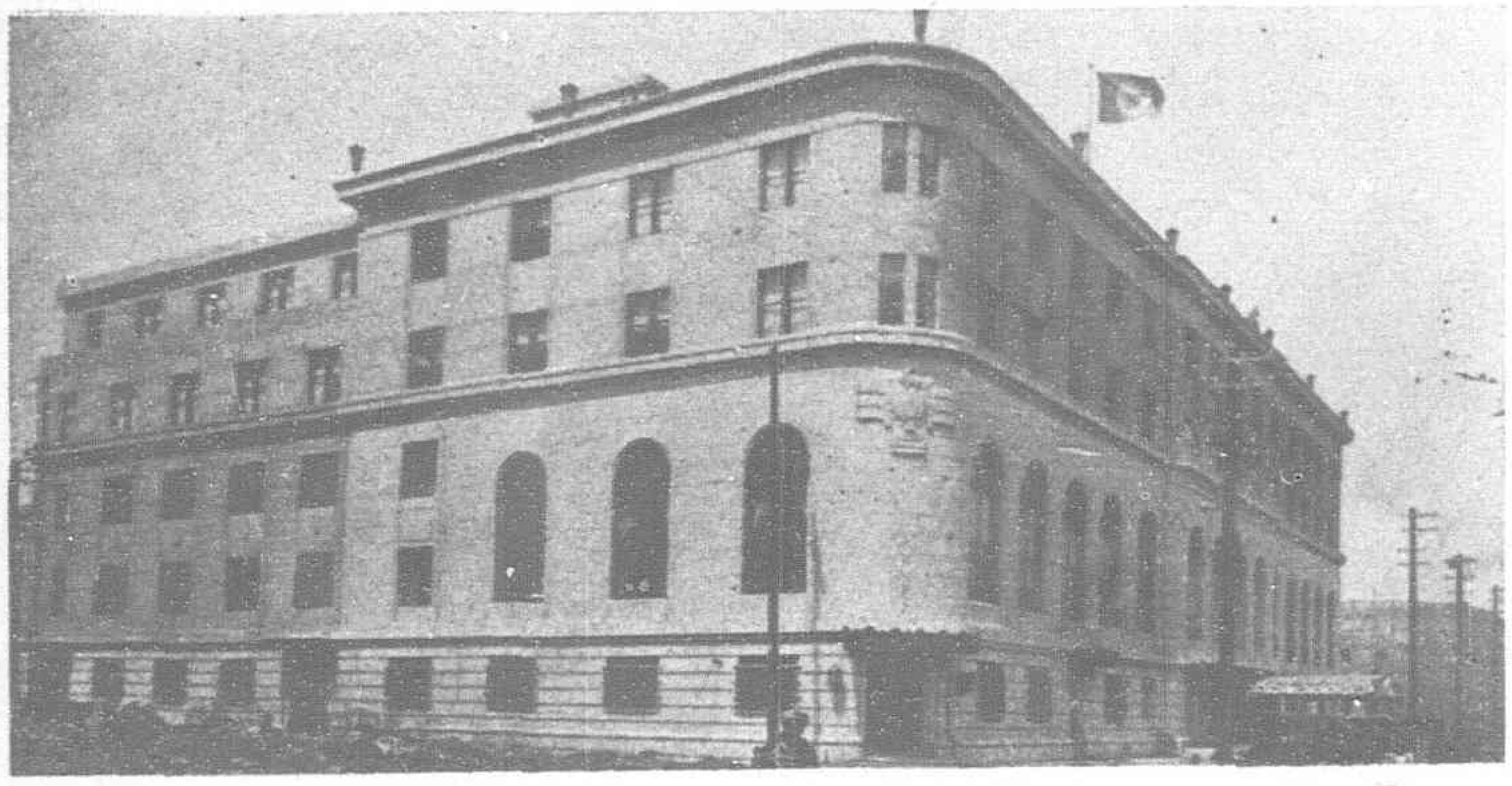
The reconstruction of the cities of Tokyo and Yokohama is one of the most comprehensive projects ever undertaken by a modern

Prefectural Office of Kanagawa

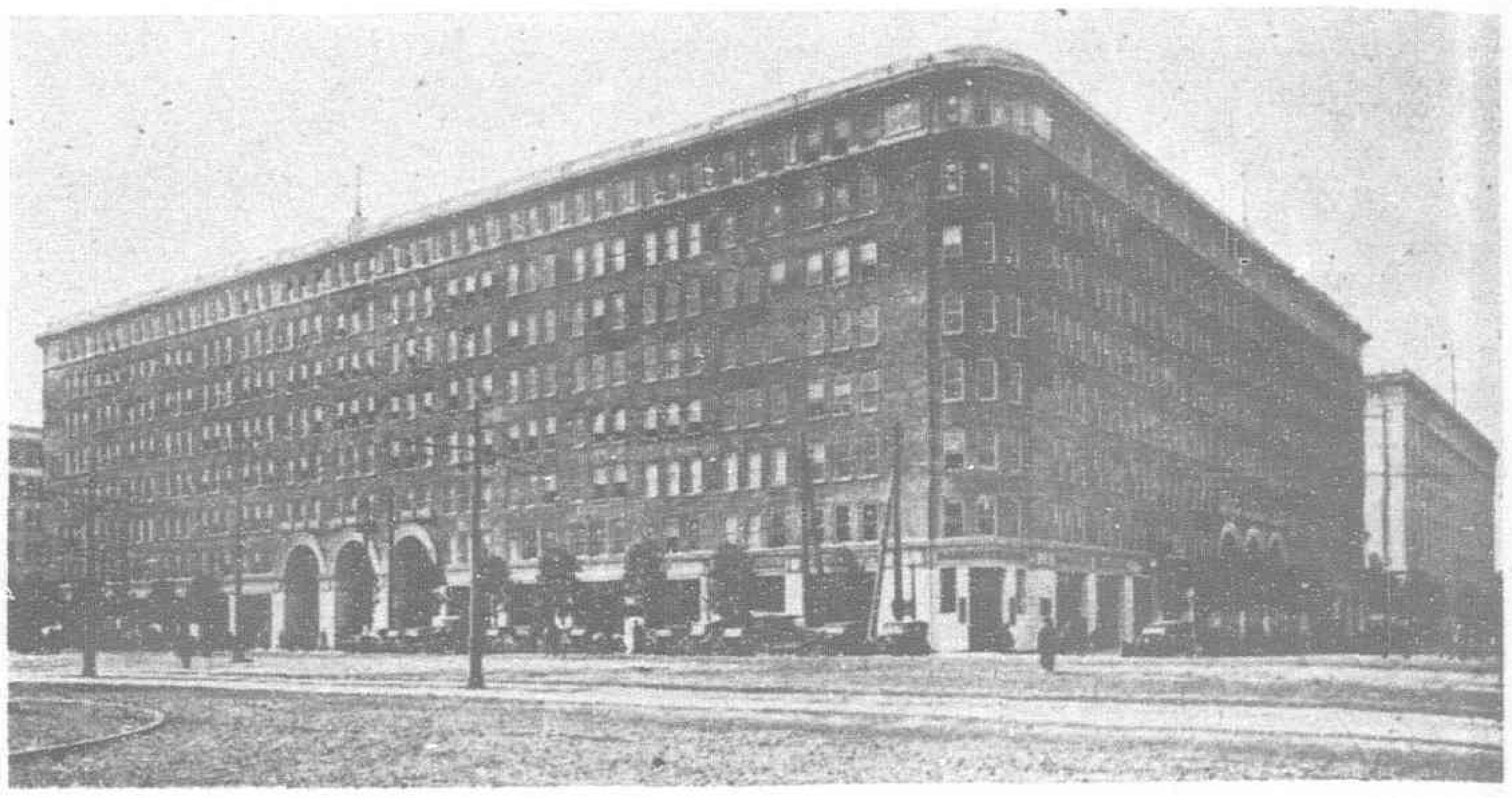
The Ginza Street from the Roof of Matsusakaya Store, Tokyo

English Equivalents of Japanese Units.—A very common Japanese unit of area is the tsubo, which is equivalent to 36 square shaku. One shaku equals 0.994 foot, hence 1 tsubo is equivalent to 35.6 square feet; 1,224 tsubo equal 1 acre. Some areas will be given in this unit, as it is the most convenient one for measuring small plots. Large areas will in general be reduced to acres. Some metric units will be used where these are used in Japanese official reports. In general, the Japanese units will be reduced to the equivalent English units.

The following are the average values of the yen for the years 1922 to 1926 : 1922, $0.4775 ; 1923, $0.4771 ; 1924, $0.41 ; 1925, $0.41 ; 1926, $0.4712.



New Grand Hotel, Yokohama



Marunouchi Building, Tokyo

community. In order to appreciate fully the magnitude of the undertaking it is necessary to keep in mind that the work does not deal exclusively with the repair of the damage caused by the cataclysmic earthquake and fire of September, 1923. To repair that damage would be largely a matter of private initiative. The reconstruction program was inspired by and necessitated by the destruction of these cities in 1923, but its scope transcends the mere repair of damage. It amounts, in fact, to the remodeling of an oriental city on occidental lines, to a systematic and revolutionary adaptation to modern requirements, instead of a haphazard, evolutionary process by which most cities become modernized. The greater part of the enormous municipal and National Government reconstruction budget of three-quarters of a billion yen is for modernization rather than for repair of the damage wrought.

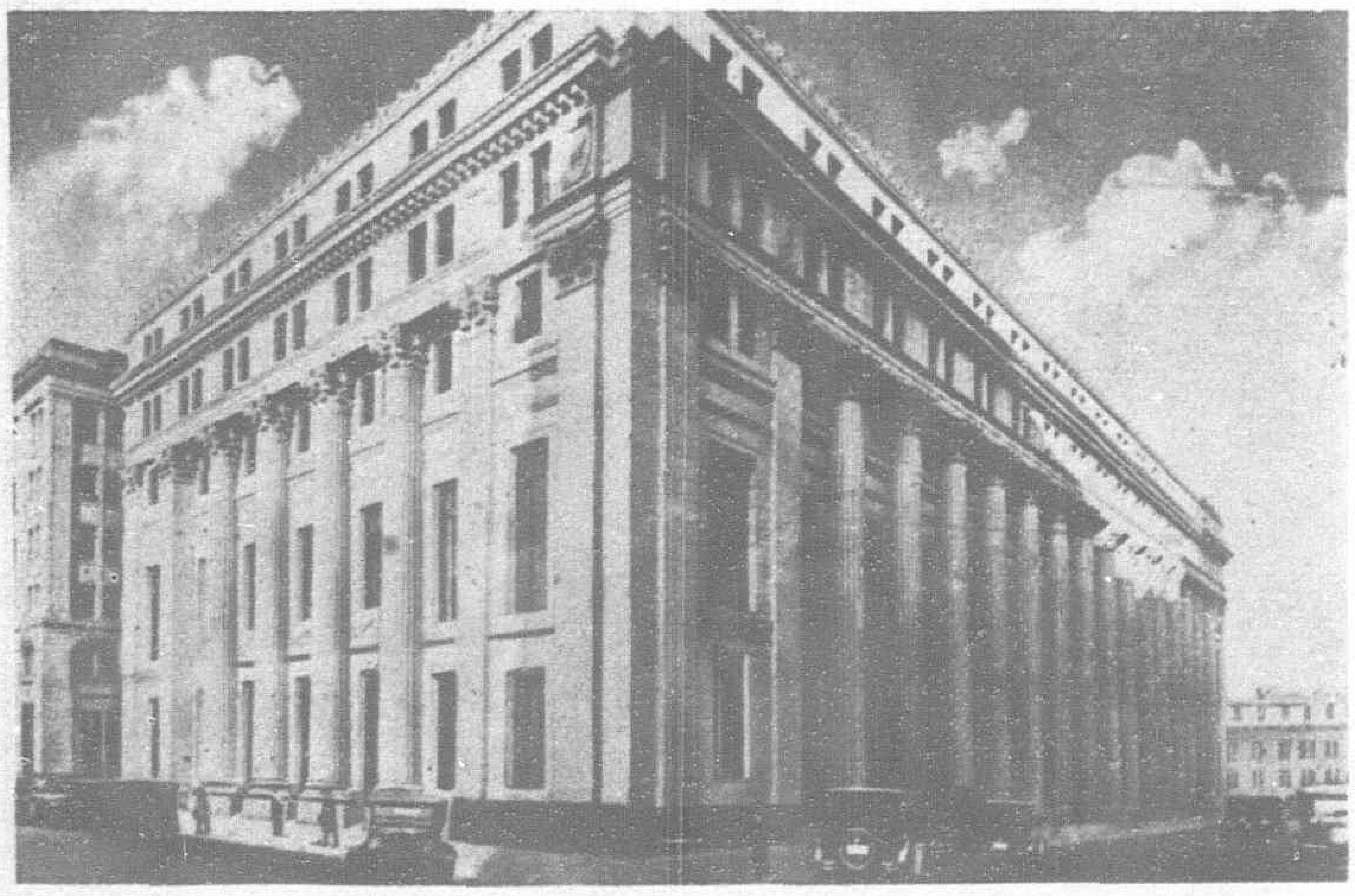
The Matsusakaya Department Store, Ginza, Tokyo

When it is realized that Tokyo is a city of 2,000,000 people and covers an area of about 20,000 acres it is apparent that replanning nearly one-half of this area, relocating streets, readjusting private boundary lines, and rebuilding the city on the new plan is a stupendous undertaking. In many cases the creators of the new city have boldly ignored existing thoroughfares and have drawn their plans as though they were working on a new project of undeveloped land, making their plans satisfy uncompromisingly the requirements of modern transportation and living.

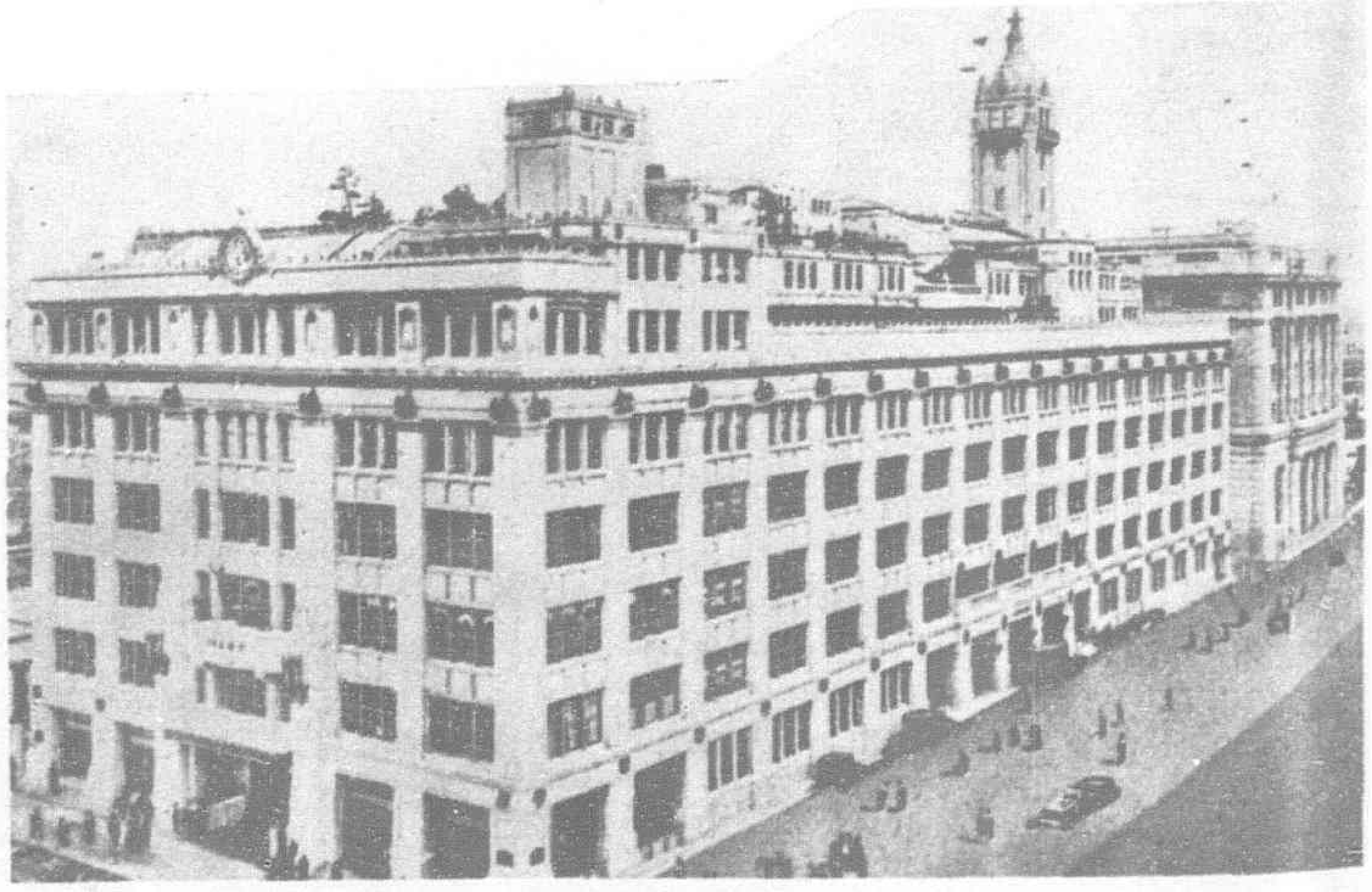
The problem of obtaining approximately 15 per cent. additional area for streets from private-property owners has been a most difficult one. The increase in the total area of streets from 11.6 per cent. to over 25 per cent. of the total area of the city necessitated a complete reallotment of property to private owners and involved three and one-half years of work on the part of the large staff of the Reconstruction Bureau and the expenditure of many millions of yen. In the destroyed half of the city where most of the radical adjustments are being made the area devoted to thoroughfares is to be 28 per cent.

The controlling factors in the reconstruction program for the city of Tokyo by the Government were: (1) Provision for modern transportation of goods and people by wheeled and motor vehicles of all sorts and by street-car and rapid-transit systems; (2) construction in keeping with the dignity befitting a modern imperial capital; (3) reduction of fire hazards and provision for places of refuge from fire and earthquake by the establishment of fireproof zones and the creation of wide streets and parks; (4) the creation of facilities for more economic functioning of the community by the establishment of a zoning system for industrial, commercial, and residential structures.

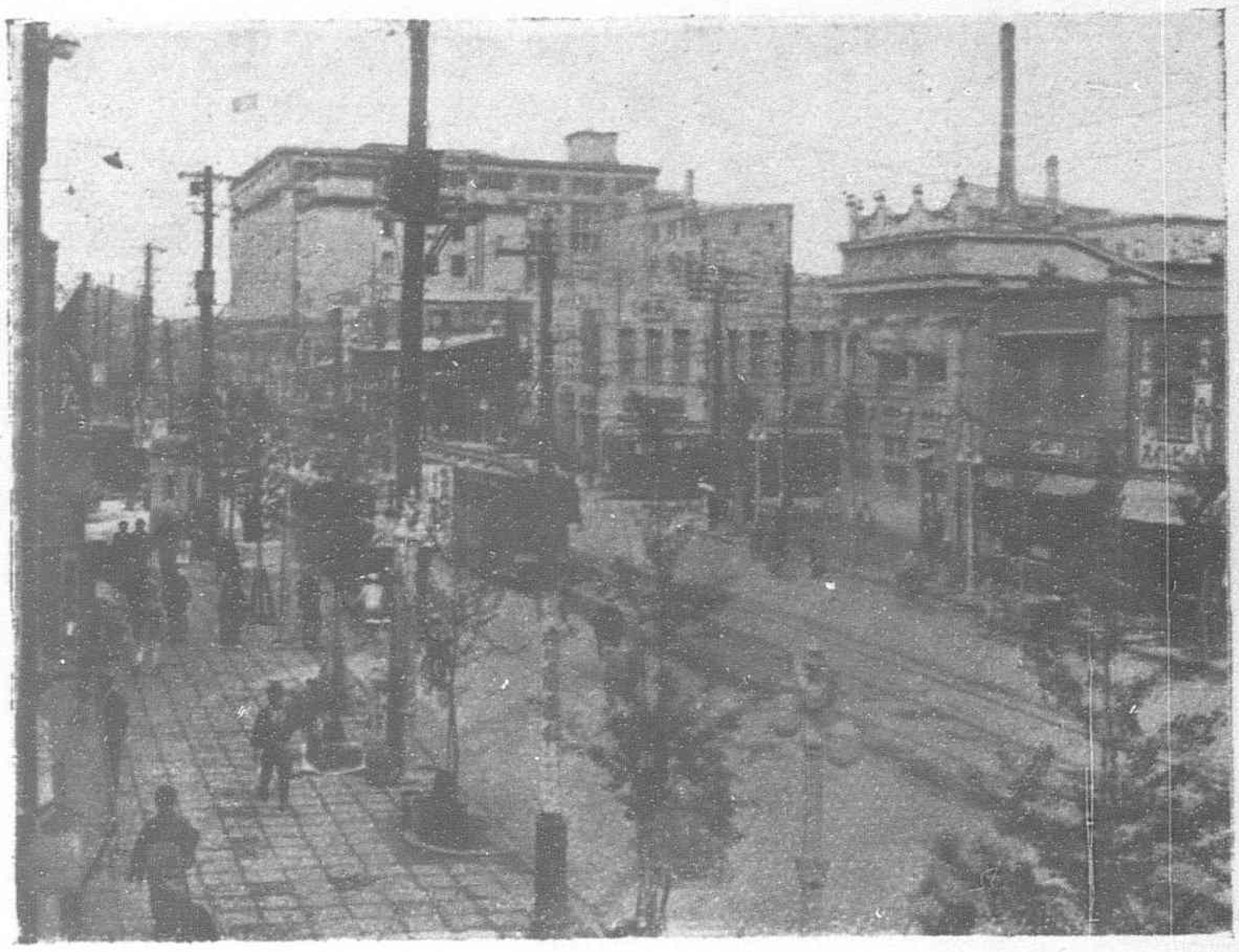
To do all this involved a radical departure from the plan of old Tokyo. It is difficult for westerners to appreciate the radical changes necessitated, and some of the regulations drawn up would appear superfluous or unintelligible to the occidental. A ruling that the building lines on any street should in the future be at least 12 feet apart, and that sidewalks should hereafter be placed on streets having exceptionally heavy traffic,



The Mitsui Bank, Tokyo



Mitsukoshi Department Store, Tokyo



The Ginza, Tokyo

gives an indication of the former state of affairs in old Tokyo, with its seventeenth century design and its closely built-up, narrow alleyways carrying a dense traffic of automobiles, bicycles, rickshaws, horse-drawn teams, pedestrians, babies, dogs and chickens, trying to live the life of the twentieth century.

Although street widening was planned for the entire city, the more radical program of complete land readjustment is being carried out in the destroyed half of the city, which includes the leading business and industrial districts; while in the half of the city where damage was small street widening has been carried out without such radical changes.

The reconstruction plans for Yokohama do not involve the fundamentals of replanning in so great degree as is the case in the reconstruction of Tokyo. Only one-third of the destroyed area in Yokohama is to be replanned and subjected to radical land readjustment. The irregular topography of many parts of Yokohama prohibited radical changes in property lines, and the elements of city planning were not present as in Tokyo. Sections to be radically adjusted and replanned include the railroad station and pier districts and the principal business sections.

Reconstruction of the Tokyo-Yokohama district can be differentiated into two main divisions—governmental reconstruction and private reconstruction. The plans and surface work are almost entirely a Government project, and the building work is largely private. It is obvious that where fundamental property readjustments had to be carried out private reconstruction had to be postponed till the completion of the ground plan. Hence, the work of reconstruction to date has consisted in large part of the Government's groundwork project.

Building, however, is now assuming large proportions in main business thoroughfares, where the largest and most expensive buildings are being erected, owing to the fact that the ground plan has been long since decided upon. Moreover, the destruction of many of the principal business and office streets was not so complete as to warrant extensive readjustment of property and building lines, and hence building work in such places has proceeded unhampered by the necessity of waiting for property readjustments and has consisted in the replacing of old or damaged structures by better ones.

In this report the surface work by the governmental bodies will first be considered, then other lines of work undertaken by the Government, and, lastly, private building work will be mentioned.

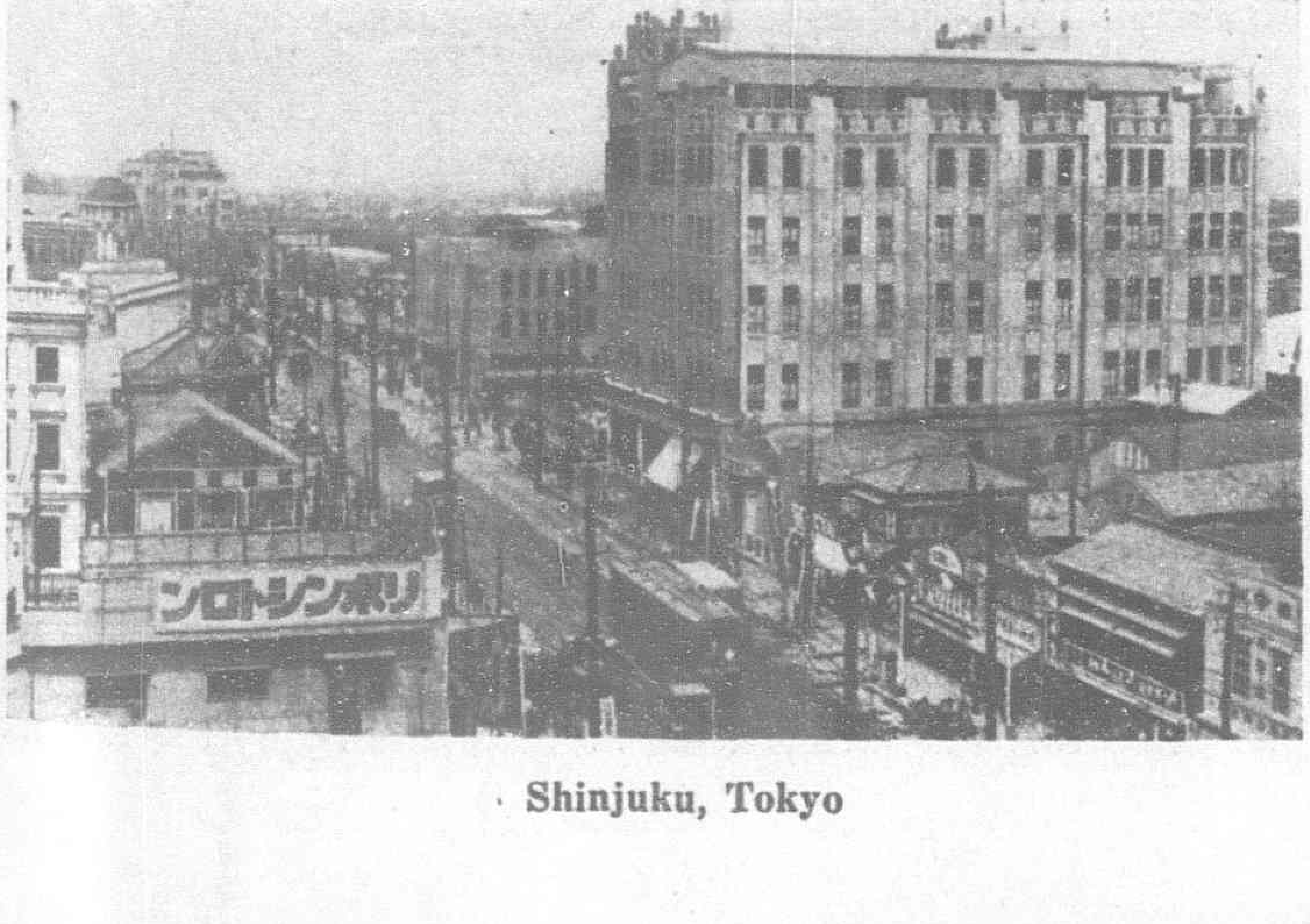
Owing to the fact that the reconstruction of the Tokyo-Yokohama district involves a complete new plan for the city of Tokyo, and to a minor extent also for Yokohama, it is essential to describe the new road and street construction and work incidental thereto, such as land readjustment, bridge and canal reconstruction, and city planning. as this work constitutes the most important phase of the entire reconstruction project and provides the groundwork upon which the new Tokyo is arising.

City Planning

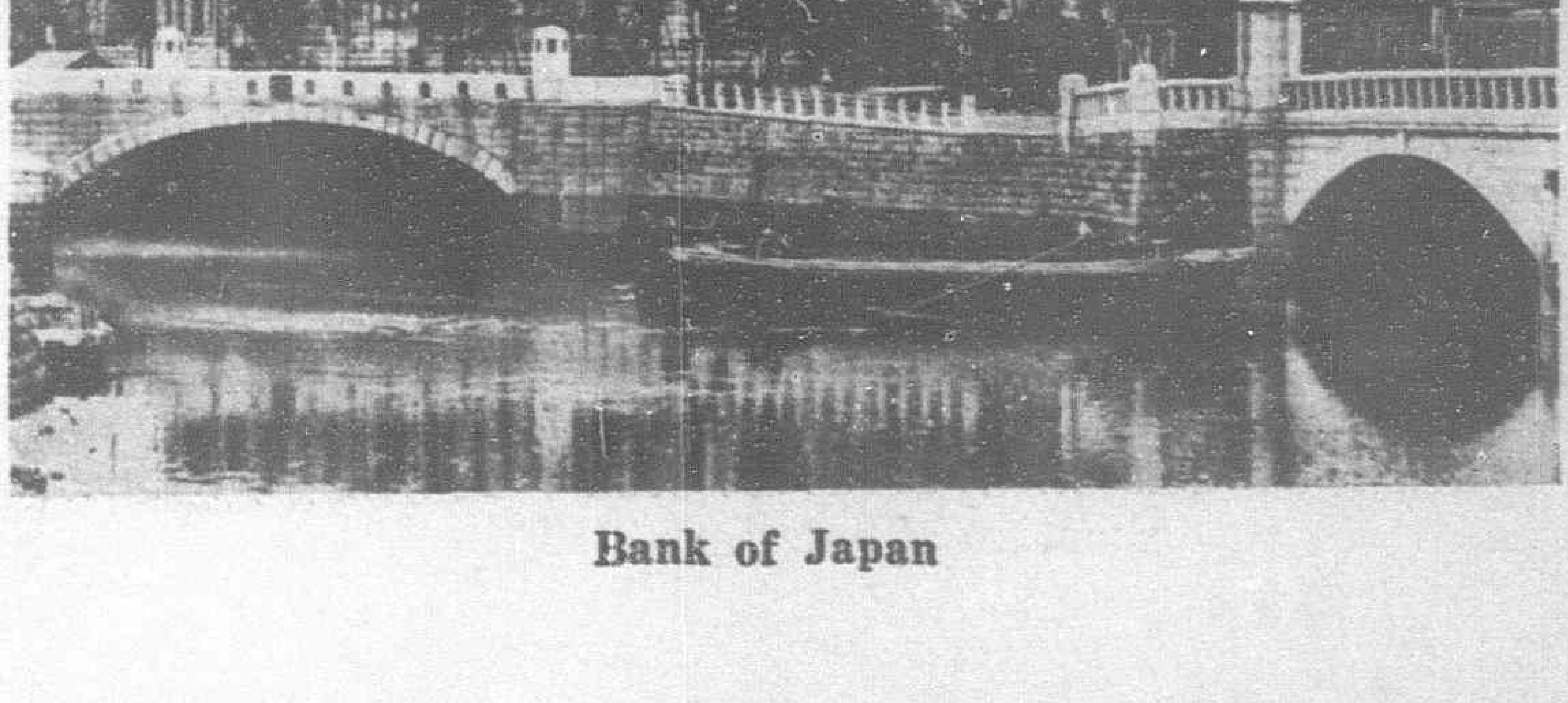
Several committees on city planning appointed by the national and local governments prior to the great earthquake had worked upon the proposal to make of Tokyo a new and model capital and had drawn up an elaborate and comprehensive program for the gradual evolution of the city from a feudal capital to a great modern metropolis. Consequently, there was available at the time of the catastrophe a carefully prepared plan which formed the basis for rebuilding Tokyo from the earthquake ruins. In view of the elaborate plans which had been evolved, it was inconceivable that the city should be rebuilt on the old plan, and as a groundwork for the reconstruction immediate preparations were made for putting into execution the replanning of Tokyo.

This inevitably delayed the actual building of permanent structures in the city until the completion of the work of ground planning, and great numbers of temporary structures, locally called barracks, have been built. These were to have been torn down within five years, but it is probable that part of these structures will remain for some time to come. In particular, those which have some resemblance to the minimum sanitary requirements of a Japanese house will probably be allowed to remain more or less permanently. During the process of land readjustment nearly all of these had to be moved onto new land. This called for an enormous amount of detail work showing the exact movement schedule for each of over 200,000 houses. Although a remarkable rate of progress has now been reached in the moving of houses, it will require some years to complete these removals and to replace the barracks by permanent structures.

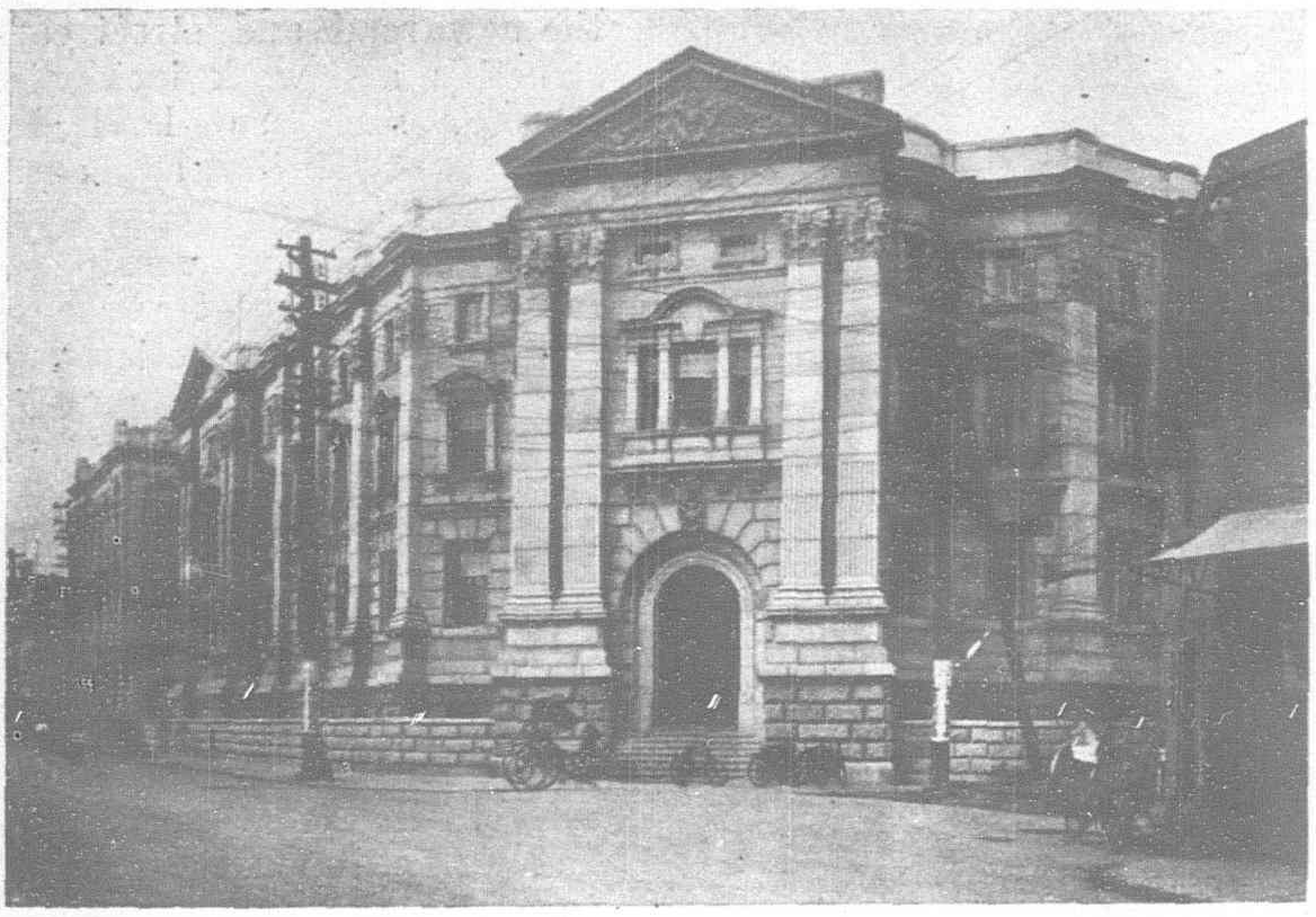
One of the greatest problems was the necessity of reducing fire hazard. Fireproofing is really of greater importance than elaborate preparations for withstanding earthquakes. Earthquake shocks cause great damage to buildings and a moderate loss of life, but the losses due to the accompanying fires are appallingly greater. Reducing the fire hazard took three distinct forms : First, the creation of fireproof zones and lines in vital sections which would check the progress of any great conflagration from one inflammable district to another ; second, the construction of wide streets to assist further in breaking fires, and the replacing of narrow alleys in congested



Shinjuku, Tokyo



Bank of Japan



Yokohama Specie Bank, Yokohama

districts by streets to facilitate egress in case of danger ; third, the planning of parks in many parts of the city to provide places of refuge for great numbers of people, especially in the vicinity of schools.

Some attempts have been made to zone the city into residential, business and industrial sections. This will be carried out as conditions permit, although the Japanese custom of combining a home with a small shop will result in the domiciling of many families in so-called business districts.

The type of construction of residential and small business property in Tokyo is such as to make the normal fire hazard very great ; hence these wide streets and other fire precautions are desirable from the standpoint of protecting the city from ordinary fires, and are absolutely essential for protection from the devastating conflagrations which follow severe earthquakes.

Land Adjustment

The readjustment of private property in the city of Tokyo, decided upon in connection with the reconstruction of the city on modern lines, is one of the most formidable undertakings ever attempted by a modern community. It would be impossible to carry out such a project in an American or European city of equivalent importance and it would have been almost impossible to carry out even in Tokyo had it not been for the almost complete leveling of the areas in question.

Of the total area of 19,600 acres of the city of Tokyo, an area of 7,550 acres, practically identical with the ruined districts, was designated as a region where the execution of the city plan required a complete readjustment of private property and boundary lines. In March, 1924, notice was given as to the sections in which this radical program was to be carried out. The destroyed area was divided into 66 sections, of which 15 sections, with an area of 1,500 acres, were to be cared for by the Reconstruction Bureau and 51 sections, with an area of 6,050 acres, by the city of Tokyo.

In Yokohama the destroyed area to be readjusted was 820 acres divided into 13 sections, six of which, covering 405 acres, were to be handled by the Reconstruction Bureau and seven sections, covering 415 acres, by the city.

Land readjustments had been carried out on a small scale by Tokyo prior to the earthquake, in accordance with the plans of various city-planning commissions, as poor designing of the city years ago had hampered its economic functioning. The conditions which had existed before the earthquake were fast becoming intolerable. The earthquake furnished the opportunity and the incentive for an immediate large-scale application of the city-planning scheme.

Inasmuch as the cities of Tokyo and Yokohama were hardly in a position to finance such fundamental work while engaged in building up the devastated districts, the National Government agreed to subsidize many of the essential undertakings, and actually undertook the execution of many parts of the program.

The work of land readjustment involved very delicate questions. The matter was undertaken on the basic assumption that property owners would ultimately be benefited by the redesigning of the area through a more economical arrangement of the city with its widened streets and similar improvements. It was therefore decided that all property owners should be required to give up, without compensation, 10 per cent. of their land holdings. The total thus acquired was considerably less than the total needed for street widening.

Various conditions necessitated great elasticity in the system, on account of the complexity of the requirements of various landowners. Some plots could not spare a 10 per cent. reduction in area without interfering seriously with the structures located thereon. In such cases the owners were assessed a penalty for the privilege of keeping their land intact. The fund accumulated from these penalties was used to reimburse those property owners who were, as a result, compelled to give up more than 10 per cent. of their property.

It was decided to readjust each of the 66 sections as a complete unit. Each landowner and landholder in each section was to receive new land in that particular section. Some complications arose from the fact that in some cases the land and the buildings situated thereon had different owners, and as a result it was difficult to satisfy both the owner of the land and the owner of the building with the newly allotted plot. Business requirements of various owners were met as far as possible in the redistribution of land. For example, business establishments with locations in pre-earthquake Tokyo were given the identical locations under the new allotment if the need of their business required such consideration.

In each section committees of 30 were formed from landowners, tenants, and officials, to discuss details concerning reallotment of land, moving schedule of buildings, and compensation to be received. The city and the Reconstruction Bureau, in their respective areas, made final decisions in these matters, against which no appeal could be made.

The total amount of land expropriated in the 66 sections under consideration amounted to nearly 16 per cent. of the area of this devastated region. The proportions expropriated varied from 1 per cent. to over 20 per cent. for different sections. The average was somewhat over 15 per cent. of the total area of all sections. Inasmuch as 10 per cent. was to be given without compensation and the total amount taken was 16 per cent, six per cent. of the total area had to be purchased outright. This was done as part of the work of the committees in the separate sections in connection with their levying of the 10 per cent.

The price scale was made as systematic as possible. Index numbers were used to designate differentials to be applied to land values for corner locations, for land of different ratio of depth to frontage from the standard, and for land of side streets. The basic value was set in each minor locality as essential, there being 50 different base values of land designated, and each of these being adjusted by the differentials above-mentioned.

It was decided to treat large parks and markets in a distinct category and to obtain the large tracts necessary by outright purchase, preferably in sections of the city not being readjusted.

The prices paid varied from about Y.75 per tsubo to a maximum of Y.2,500 per tsubo (36 square feet). No attempt was made to assess on the basis of the value of land in the district in ruins, but a fair allowance was made, giving due consideration to the past value and to the prospects of any section of land for regaining its previous value under the reconstruction plan. While, nominally, only 15 sections were adjusted by the Reconstruction Bureau of the National Government and 52 sections by the municipality of Tokyo, in fact the readjustment may be said to be almost entirely a National Government undertaking. Although 52 sections were assigned to the city for readjusting, it was found more practical for the Reconstruction Bureau to undertake some of this in conjunction with the city. The city received from the National Government a direct subsidy of two-thirds of the amount to be expended for land readjustment and purchase, and the remaining one-third was loaned to the municipality by the National Government. Even the interest on this one-third is being met temporarily by the National Government.

Reconstruction Budgets

The amounts included in the reconstruction budget for land adjustment work are as follows:

	Yen
TOKYO:	
Reconstruction Bureau's portion	8,750,000
City's original estimate	33,951,000
Additional allowance to city	16,000,000
Total	58,701,000
YOKOHAMA:	
Reconstruction Bureau's portion	2,561,000
City's portion of original allowance	4,179,000
Additional allowance	3,000,000
Total	9,740,000
Grand total for Tokyo and Yokohama ..	68,441,000

In addition to this, it should be understood that the subsidy for the moving of houses is not included in the reconstruction budget but is a direct subsidy from the National Government.

Land costs have proved to be much higher than originally estimated and land already arranged for purchase has averaged Y.225 per tsubo. It is estimated that a total of over Y.90,000,000 will be required for land purchase alone in the city of Tokyo. Hence the present budget of Y.68,000,000 will probably prove to be short by at least Y.40,000,000 which must be obtained in the future.

Land readjustment is now completed both in Tokyo and in Yokohama except for a few minor districts. In August, 1927, the records of the Reconstruction Bureau showed the following:

City	To be adjusted	Adjustment plans completed	Percentage of plans completed
	Tsubo	*Tsubo*	
Tokyo	5,993,378	5,965,968	99.5
Yokohama	673,088	673,088	100.0

Readjustment of the titles to the newly allotted areas is not yet completed, nor has reimbursement been made or even agreed upon for the above area, but the plans are completed as mentioned.

Moving of Houses

Following the reallotment of land under the land readjustment program, it was necessary to move over 200,000 houses in the city of Tokyo and about 20,000 in the city of Yokohama to their new locations. This involved a very carefully drawn-up plan, and although the work proceeded slowly at first, a rate of 5,000 houses a month has now been reached. The authorities have hopes of reaching a maximum rate of 7,000 houses a month. While most of these are small, light, wooden structures which can be easily moved, there are also many heavy structures which require shifting. The work is being carried out by private property owners themselves, with some assistance and advice from the Reconstruction Bureau, and the costs are in large part covered by a subsidy from the National Government amounting to Y.40 per tsubo of actual house area, with some variations for the nature of the building and other conditions. It is estimated that at the present time nearly 60,000 houses have been moved in the city of Tokyo and about 10,000 in Yokohama.

The following table shows the status of the house-moving program on August 8, 1927, taken from the records of the Reconstruction Bureau. This shows the work divided into three classes, covering the sections adjusted by the Reconstruction Bureau, those adjusted by the municipality, and, lastly, those adjusted by the municipality in co-operation with the Reconstruction Bureau. From two to four years will be required to complete the moving of buildings, the work being approximately one-third completed at this (October, 1927) time.

TO BE DONE BY	NUMBER OF HOUSES TO BE MOVED	NUMBER OF HOUSES ALREADY MOVED	PERCENTAGE OF COMPLETION
TOKYO:			
Reconstruction Bureau ..	41,460	20,251	48.8
Municipality assisted by Reconstruction Bureau ..	74,946	13,500	18.0
Municipality..	85,031	19,011	21.2
Total	201,437	51,761	25.7
YOKOHAMA:			
Reconstruction Bureau ..	10,197	5,485	53.8
Municipality..	8,750	3,423	39.1
Total	18,947	8,908	47.0
Grand total, Tokyo and Yokohama.. ..	220,384	60,670	27.5

A table has been prepared showing the condition of house moving and consequently the preparation for starting permanent and new buildings in each area, in order to give to those interested in or familiar with the district an idea of the progress in various sections of the city. The total estimated amount of the subsidy for the moving of houses is Y158,000,000. Of this amount Y.40,000,000 has already been spent by the National Government. This subsidy is not included in the reconstruction budgets of the city or of the Reconstruction Bureau, but is a direct subsidy from the National Government.

Worthington Power Plant Equipment in Manchuria

AMONG the many Worthington equipped power plants erected throughout China during the present decade is that of the Mukden Electric Light Company. The initial installation of a 1,500 kw. power station was made in 1920. For this station the steam turbine and generator were supplied by the International General Electric Co., and the 5,000 sq. ft. condenser with auxiliaries was supplied by Worthington.

This plant was designed for a steam consumption of 15.1 lbs. per kw. hr. operating with an absolute exhaust back pressure of two inches absolute. A wet vacuum pump of the Edwards suction valveless type and a closed feed-water heater were also included in the units furnished by Worthington.

Although of comparatively small size the handling of this equipment from the railroad siding to the plant site involved a transportation problem of considerable magnitude

No sooner had this plant been put in operation than the rapid increase in demand for electric power necessitated an extension of facilities and as a result of the highly satisfactory performance of the original equipment a second call was made on Worthington in 1922 for a 6,325 square foot surface condenser and auxiliaries to be used in connection with a 2,500 kw. General Electric steam turbo-generator having a steam consumption of 14.6 pounds per kw. hour operating with two inches absolute back pressure.

Again, in 1927, industrial progress resulting from the development of Manchuria's great resources has necessitated a second extension greater in capacity than the original plant plus the first extension. This new plant is rated at 5,000 kw. and is laid out on the most modern lines as may be judged from the steam consumption at full load of 10.6 lbs. per kw. hour.

A large part of the improvement in the economy of this second extension over the performance of the preceding installation is attributed to the increase in boiler pressure from 175 lbs. to 300 lbs. Then too, instead of the wet vacuum pump, Worthington supplied a two-stage centrifugal condensate pump and a steam jet air ejector having a jet inter cooler and surface aftercooler.

The surface condenser supplied by Worthington is of the two pass type having 7,800 sq. ft. of cooling surface, and, as formerly, operating with two inches absolute back pressure.

The consistently good performance of Worthington equipment in this power station, as proven by the three separate installations, adequately explains why condensers and auxiliary equipment for forty steam power plants in China have been ordered from Worthington during the past nine years. These condensers vary in size from 300 to 36,000 square feet and have, without exception, given complete satisfaction.

How Yellow River Bridge of Tientsin-Pukow Railway was Lifted and Repaired for Traffic

By Tsu Y. Chen, B.S, C.E., Assoc. M. Am. Soc. C.E., Engineer, Tientsin-Pukow Railway

In the January, 1929 issue of the "Far Eastern Review" we published an account of the "Rebuilding of the Yellow River Bridge," by Alfred Batson, a journalist who was present in Tsinan when the first train went through from Pukow. The present article on the same subject by the engineer-in-charge of the actual work is of such importance, that we reproduce it in spite of the shortness of time elapsing between the publication of the two articles.

General Description of the Bridge

THE Yellow River Bridge is remarkable in having not only an interesting Cantilever Span but also a very great total length of bridge (4,100 ft). It was built in approximately three years, from August 1909 to October 1912, by The Maschinenfabrik Augsburg-Nurnberg of Germany.

The Bridge consists of nine spans of 91.5m (300 ft) each, and a three-span Cantilever structure with Anchor Span of 128.1m. (420 ft) and a Cantilever Span of 146.7m. (540 ft). Eight of the simple spans are on the North bank and one on the South bank. The cantilever structure is level, but the approach spans are on a grade of 1:150. The rail level is about 8 meters above the high water mark and 12 meters above the normal water level.

The Bridge is intended to carry two standard gauge railway tracks, but only one is laid at present, being placed in the center of the Bridge with footways along each side. The trusses are designed for only one track, and, when the other track is required, duplicate trusses are to be added outside of present ones, suitably connected to the old trusses.

The superstructure consists of trusses of subdivided Warren type with parallel chords, except the top ones over the main piers are curved to get extra depth. The proportioning of the cantilever span is designed in such a way that each cantilever arm is one-sixth of the span length (90 ft), the suspended span, therefore, is two-thirds the cantilever span or 360 ft.

The depth of the river with its very rapid current, the soft alluvial bottom and the variable water levels, combined to make the structure difficult to erect during the early stage of construction. Undoubtedly, the Bridge represents one of the most notable engineering works in the system of Chinese Government Railways. The general features of the Bridge can be seen from Figs, 1, 2 and 3.

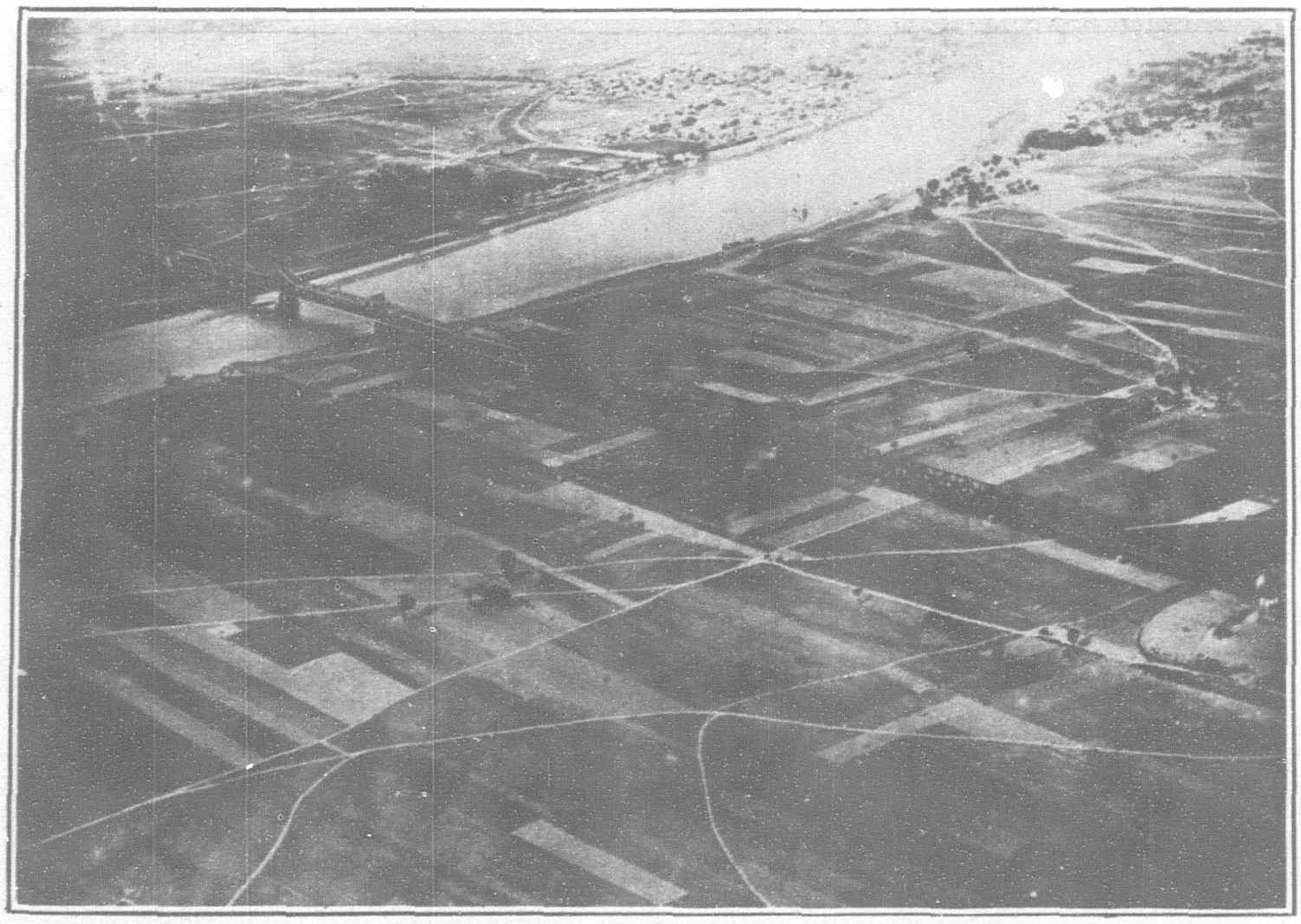


Fig. 1.—Aerial View of the Yellow River Bridge

Brief Account of Damaged Conditions

The attempted destruction of the Bridge was made by the retreating soldiers of the Chili-Shantung Army on May 1, 1928, at about 1.00 p.m. The destructive agent, supposed to be gunpowder detonated by electricity, was placed on the pier carrying the Anchor and Simple Spans on the North bank of the River. The floor system in the end panels of the said spans were totally wrecked. Four pedestals, bearing the superstructures, were entirely destroyed and scattered in all directions only remnants being found on the pier top. End posts and lower chords were damaged and flared outwards and partially left supported on the pier.

Levels have been taken along lower chords of the east and west trusses of the damaged spans, showing that the Anchor Span, with its fulcrum at the central pier, sloped downwards 1,184 mm. in east and 1,179 in west towards the North end, and the North cantilever arm tilted 230 mm. above normal level at the point where the suspended span connects, resulting an abnormal opening of the joint with a pin plate sheared off. The south end of the adjacent damaged simple span dropped 1,345 mm. in east and 1,637 mm. in west, and its north end, being on rollers, moved bodily about 80 mm., pushing against the fixed end of another span. Beyond the damaged end panels. the dropping of both spans conformed into an even grade with little deviation from a straight line. (see Fig. 4). This shows that the rigidity of the structure has not been greatly impaired. There was, however, a vertical twist on the simple span as the two trusses did not drop to the same extent, being greater on the west than on the east. Consequently, the riveted joints of protal frames and wind bracings have been loosened.

As a result of explosion, the alignment of both damaged spans has been disturbed. The simple span has been swung horizontally into a position that gives 15 mm. deviation toward west at north end, and 65 mm. deviation toward east at south end. This bodily

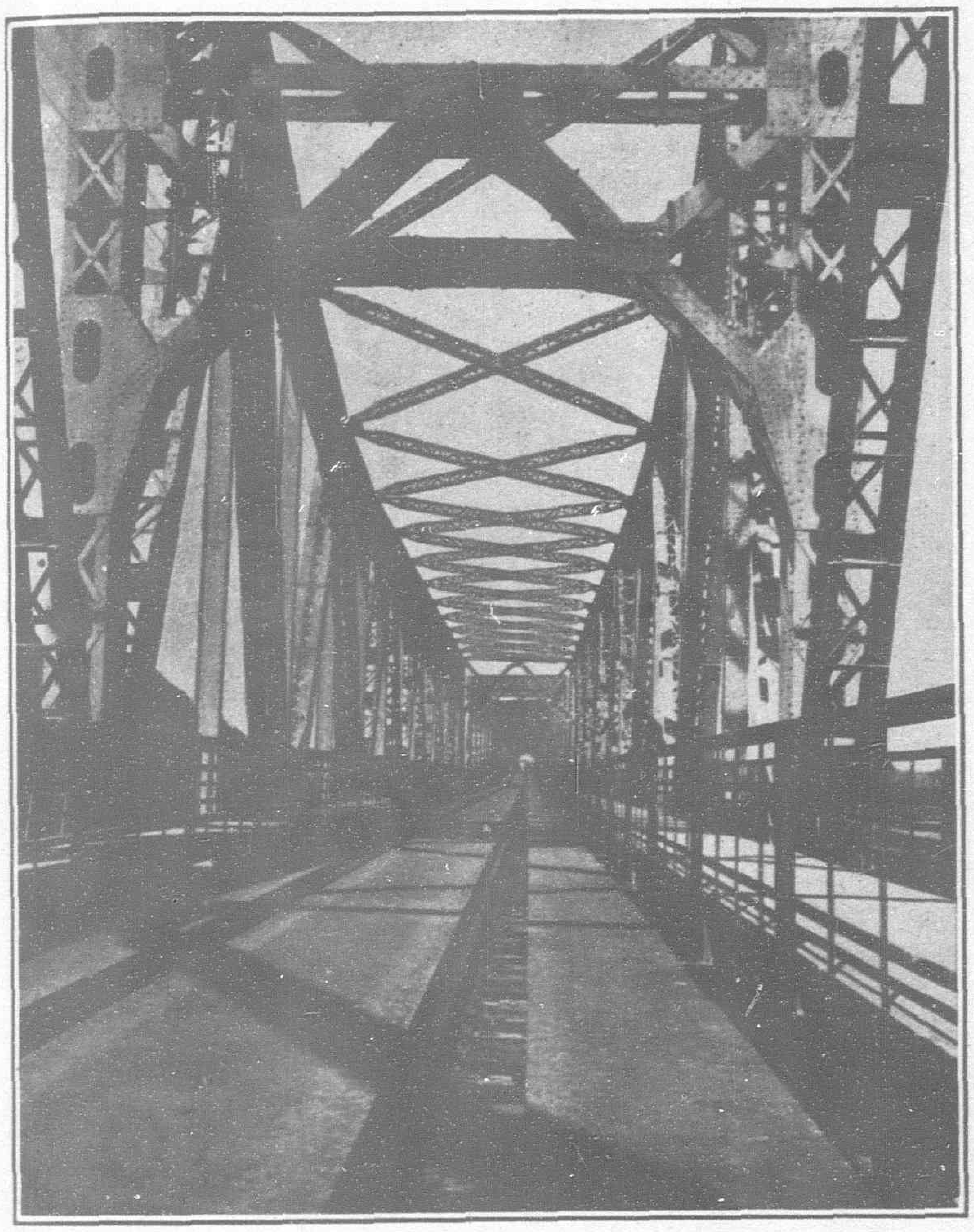


Fig. 2.—Cross Section of the Bridge

shift of span must have been attributed to the movable nature of the roller bearings at its north end. The north anchor span received much less disturbance than the simple span on account of its rigid connections at the tower post.

After the explosion on May 1, Railway Engineers hastened to the bridge site taking measurements and photographs for a preliminary report, but the incident of May 3,* prevented them from completing their investigations. Early in September, 1928, a special investigating party of engineers, of whom the writer was one, was sent by the Railway Administration. Their report of the investigations into the damaged conditions of the Bridge was submitted to and met the approval of the Ministry of Railways for the plans of lifting and repairing of the structure.

Lifting and Repairing of the Bridge

Foundations :—The region is entirely alluvial. The stream is notable for its shifting character. During dry seasons, the width of the River is practically confined under the cantilever span, but in flood times from July to September, the water spreads out over the total width between the high water dikes. The clearance between lower chord of Bridge and river bed is varied from 7 to 8 meters. Hard, tough clay is only reached from 55 ft to 65 ft. below lower water level. Therefore the foundations, bearing the temporarily jacking supports or sleeper stacks for the manoeuvering of jacks and carrying timber bents, were prepared in such a way that piling is not resorted to. Experience shows that compacted lime, sandy clay and gravel foundations with a depth of one meter will safely sustain a load of 2,000 lbs. per sq. ft. until next flood.

Weight of Bridge :—This bridge has an unusual feature of short length of cantilever arm in comparison with anchor arm. This eliminates the anchorages required at the piers carrying the ends of cantilever system. On account of this, the bridge was saved from serious damage due to the explosion on the ill-fated pier, otherwise the whole channel span might have dropped into the river. Structurally, this bridge is too squat for aesthetics and the proportioning of truss depths is far too small for economy. The amount of metal is rather extravagantly used.

From data on hand, the weight of Bridge plus track is 9,000 kg/m. for anchor and cantilever arms, and 8,700 kg/m. for suspended span. This makes the reaction at central pier 714 tons per truss and that at the end of anchor span 224 tons per truss.

Lifting Appliance :—Jacks of high capacity such as hydraulic or oil jacks enough to raise the dropping spans in single unit are not available except at great cost. In addition, experience shows that hydraulic jacks of high capacity are difficult to manoeuver and liable to accidents, while screw jacks, seldom if ever designed to lift more than 100 tons in single unit, are more reliable and easier to handle. Screw jack was chosen in preference to hydraulic, after a number of inquiries. Ten 100 ton and four 50 ton Joyce jacks were ordered from United States.

Provision at Points of Suspension :—Owing to the dropping of anchor span due to explosion, the cantilever arm was tilted with its fulcrum at center pier, causing an abnormal opening of joint where the suspended span connects. Pin plates and diaphragms were sheared off and bent. By further investigations, it is found that this does not constitute a state of danger as the load from the suspended span is transmitted through pendulum posts to the hangers of cantilever arms, and the pins are not designed to carry any load other than their specific purpose during erection. When lifting is applied under the anchor arm, the suspended span is supposed to return to its original position automatically. However, as a safety measure, two provisions have been devised at the points of suspension.

The first provision is by using ¾-in. diameter steel wire rope wound around the pin and a set of castings put against the bracket, which was originally provided for erection purpose inside the top chord of suspended span. The second is a Yoke device of I beam frame driven tight against the rocker casting of pendulum post with steel wedges. Both these provisions were designed for the same purpose and served to guide the closure of suspended span during the lifting of the anchor arm by tightening the wire rope in one and hammering the steel wedges in other.

Provisions for Maintaining Traffic :—The length of the Bridge and the great depth of the river combined to put the building of a temporary siding out of consideration. The possible solution to maintain a regular traffic is to let the trains run on the damaged spans with provisions that permit repairs be carried on with little or no obstruction, at the same time, the safety of structure kept uninjured. This resorted to a scheme that train load on its portion of the damaged spans be carried temporarily by a system of framed trestle bents, erected underneath the floor beams.

Although the exact nature of the distribution of stresses is rather uncertain, but it is quite sure that when the live load reaches these panels, the floor beams will first pick up and transmitted to the framed bents, leaving probably a very small portion to pass on to the main truss. The arrangement of bents is shown in Fig. 5.

For the end panels of both spans, the wrecked floor system have been removed, and three units of temporary stringers supported on timber bents were erected in its stead, leaving plenty of working space for the remodelling of damaged pier.

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* The conflict between Chinese and Japanese troops in Tsinan

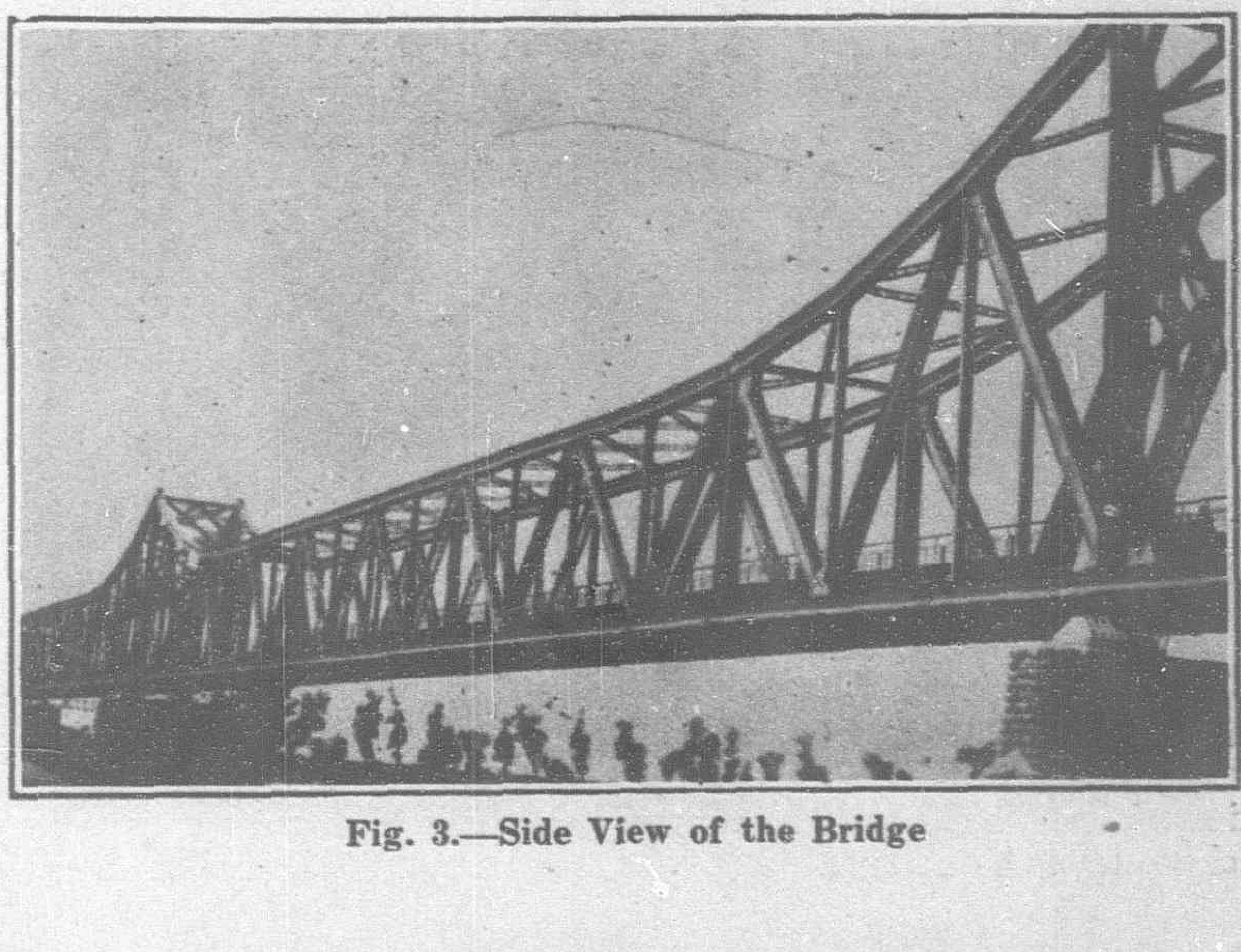


Fig. 3.—Side View of the Bridge

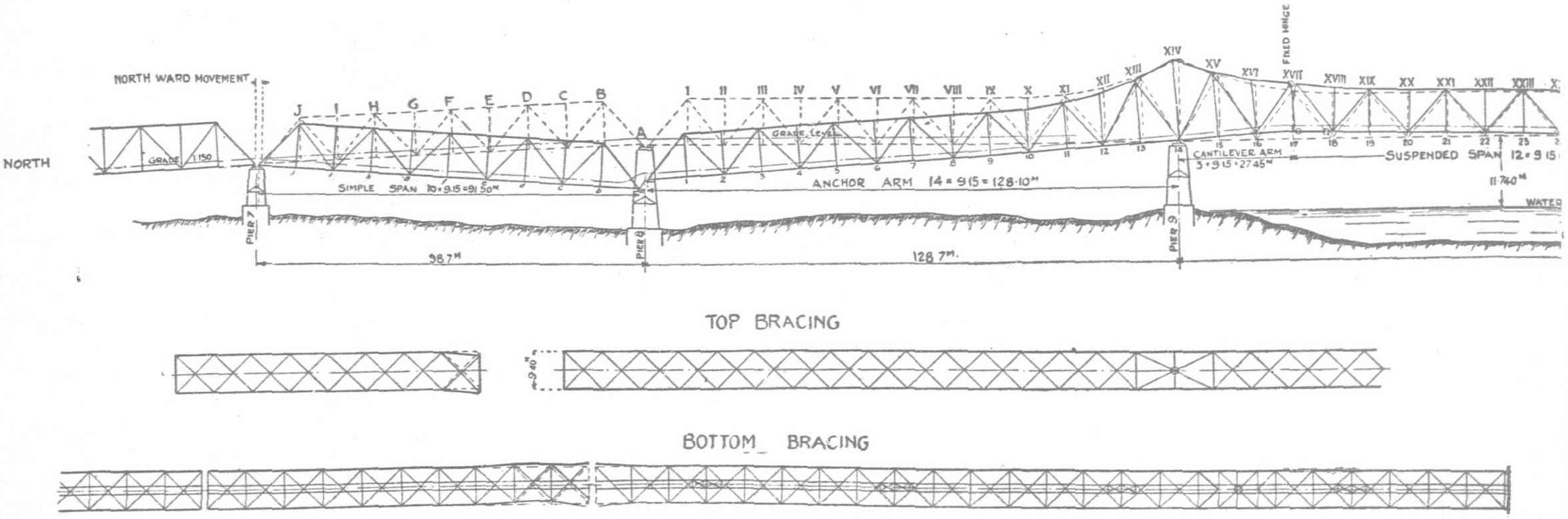

NORTH WARD MOVEMENT
NORTH
GRADE 1:150
J I H G F E D C B
A
I II III IV V VI VII VIII IX X XI XII XIII XIV XV XVI XVII XVIII XIX XX XXI XXII XXIII
FIXED HINGE
GRADE LEVEL
SIMPLE SPAN 10 = 9.15 = 91.50M
ANCHOR ARM 14 = 9.15 = 128.10M
CANTILEVER ARM 3 = 9.15 = 27.45M
SUSPENDED SPAN 12 = 9.15
11.740M
WATER
PIER 7
PIER 8
PIER 9
98.7M
128.7M.
TOP BRACING
9.40M
BOTTOM BRACING

Fig. 4.—Diagram of Damage Done to Bridge

All framed trestle bents were about five meters high, consisting of three vertical and two slanting posts, one cap and one sill, all of 12″ by 12″ Oregon Pine, well braced diagonally by 12″ x 3″ planks. There were 19 bents erected and seated on sleeper stacks, whose height made to suit the underneath clearance between the floor beam and river bed.

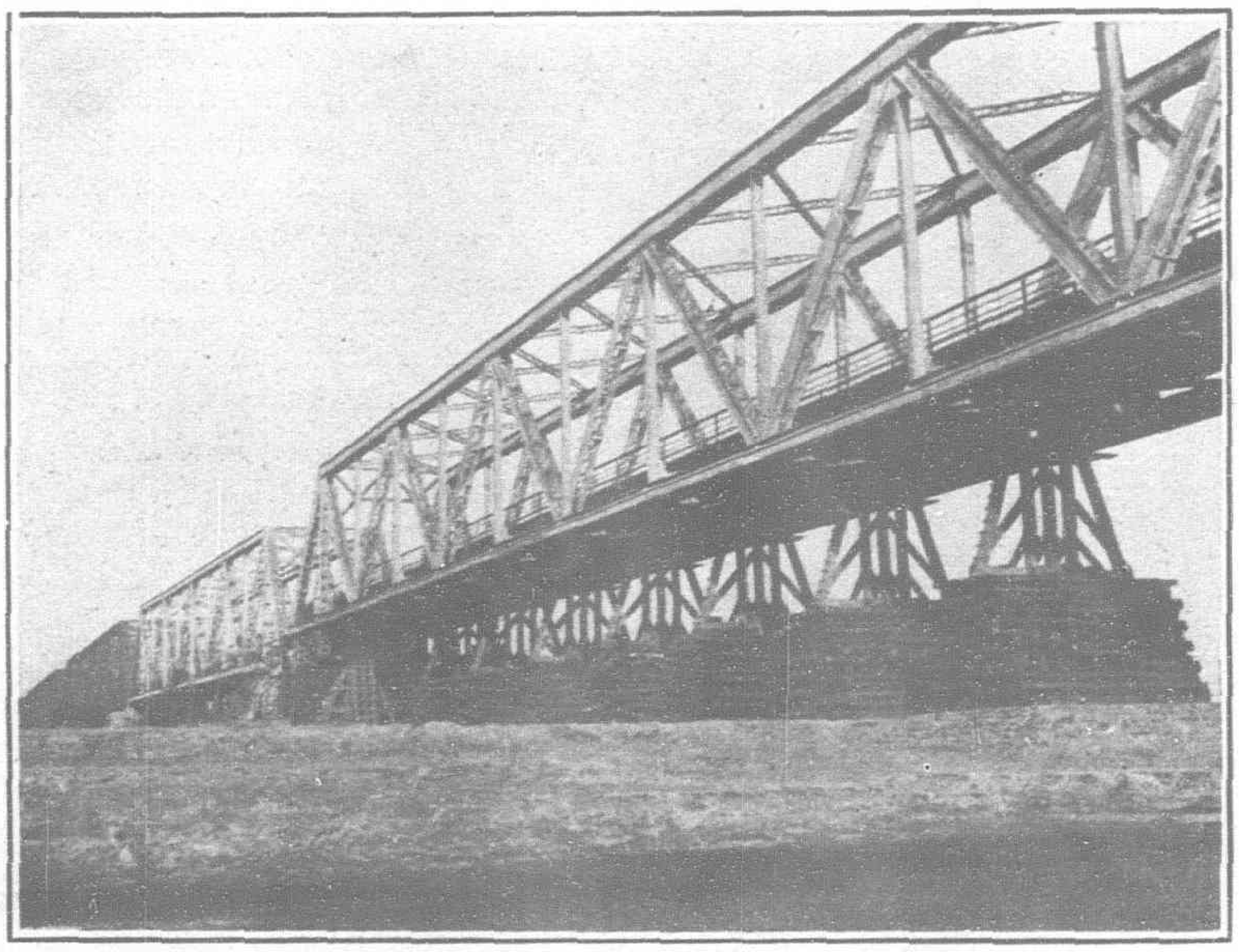


Fig. 5.—Arrangement of Traffic Bents

These timber bents were not only used to carry the live load under traffic, but served as braces to ease the strain on the jacks during lifting. As the bridge was slowly lifting up, a fraction of a millimeter at a time, these traffic bents were also raised, by the addition of more sleepers underneath or inserting hard wood wedges in between floor beams and caps.

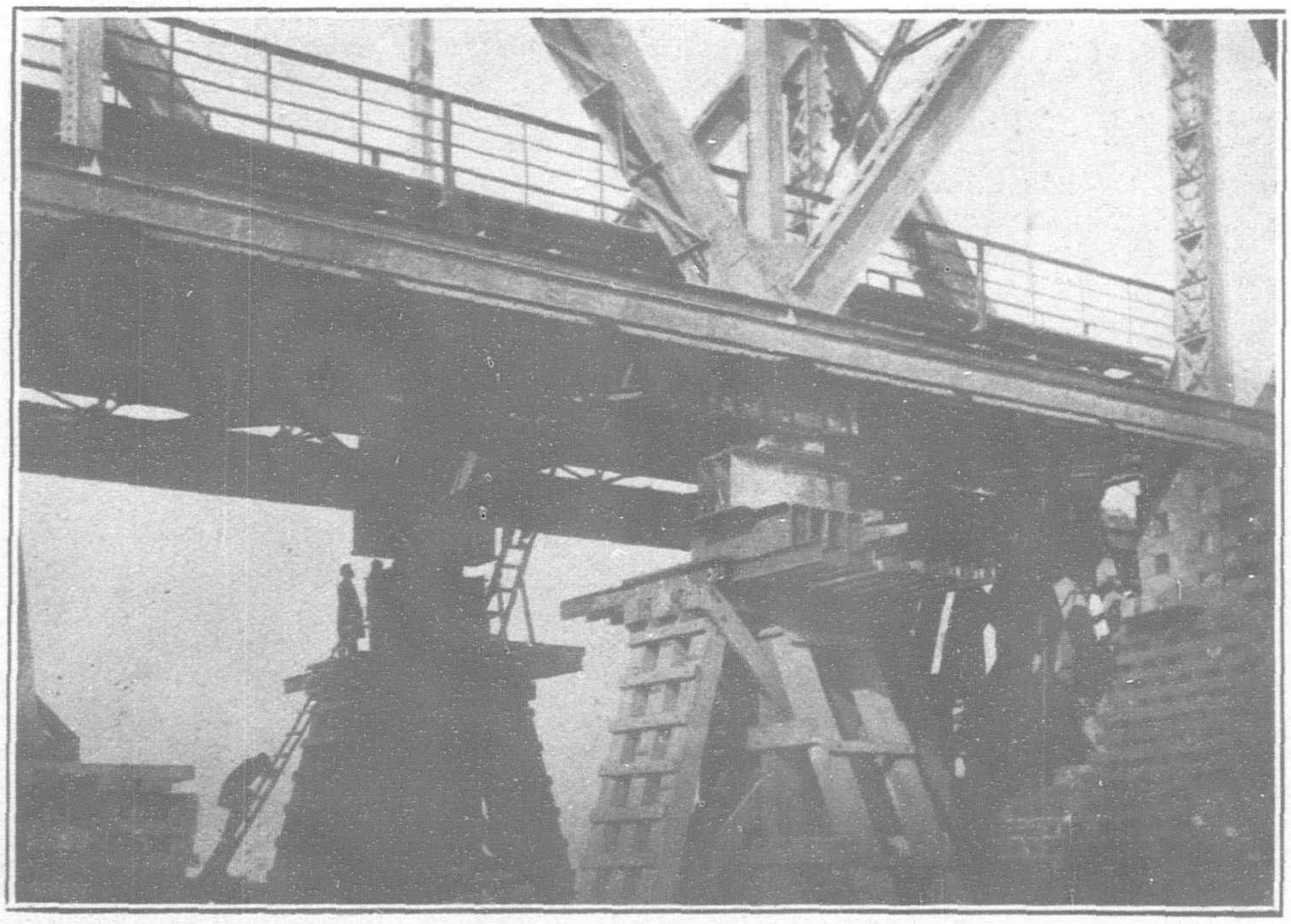


Fig. 6.—Jacking Supports

Jacking Supports:—Directly on each side of the damaged pier, four jacking supports, of heavier construction than the traffic bents, were erected upon compacted lime, sandy clay and gravel foundation. They were designed to take full dead load reaction of 272 tons plus one panel concentration of live load of 75 tons when the bridge is under traffic. The framed work consisted of six (16″ x 12″) vertical and ten (12″ x 12″) inclined posts with (12″ x 12″) caps and sills, well braced with diagonals and ties. They were mounted on a tier of 12″ x 12″ timbers and topped with a row of 250 mm. I beams, on which rest the battery of four 100 ton Joyce Jacks (see Fig. 6).

In addition to the jacking supports of heavy frame construction, there were auxiliary sleeper stacks built close to the damaged pier. A single unit of 100 ton jack or a pair of 50 ton jacks was placed on top of each, working simultaneously with the main lift. This served to support the overhanging portion of damaged span, and relieve considerably the stress in the joints.

Lifting Operations:—The work was planned after a number of rehearsals. Signals, whistles and distribution or working force were all prearranged. When order was given for the starting of jacking, the cheering songs of workmen kept the timing of strokes in manoeuvering the jacks, winding the wire rope (at the point of suspension) and hammering the wedges (at the tops of traffic bents). This scene resembles very well of conducting a large symphony orchestra; everybody is working harmoniously with others. There was not a single case of discord reported nor a single accident happened.

The lifting of bridge was about 8″ to 10″ per day while the actual time spent on jacking only two or three hours. The rest of the day was spent in building up the staging, raising up the traffic bents (or braces), rearranging the grillages and resetting of jacks for next operation.

Instrument men have been stationed in proper place to record the raising of span, and give signals if there is any difference of level between east and west trusses. The difference was corrected by regulating the rate or range of strokes in manoeuvering the jacks. A system of grillages, varying from standard rails to 750 mm. I beams, was used to support the jacks during the lifting or carry the weight of bridge when jacks are entirely removed.

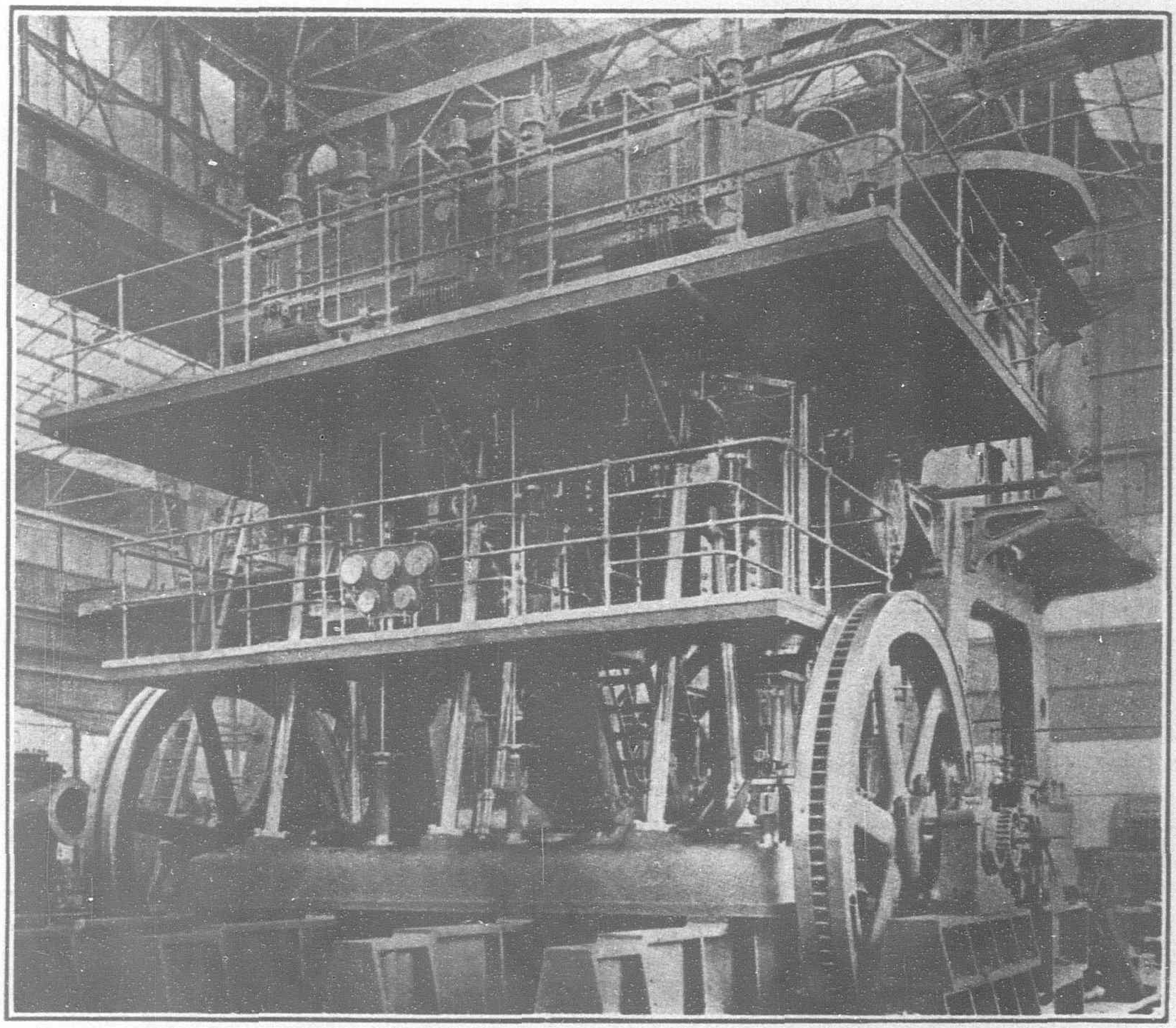
The question of temperature effect was also under serious consideration. Record shows that the anchor span will expand or contract at rate of 1.5 mm. per degree C. The range of temperature for which the bridge was designed is from—30° C to 50°C with 10° C as normal. The total movement of bridge will, therefore, be 120 mm. from extreme cool to extreme hot weather. This will certainly exert a tremendous amount of strain to the temporary timber frames, although such worst case is seldom if ever happened. It seems that some sort of expansion bearings must be provided at the tops of main supports. As mentioned in previous pages, the various units of original roller castings, which carry the anchor span, were all blown off the pier and scattered in all directions. Those odd ends were collected from the River bed and reshaped in the Railway Shop, forming an excellent expansion bearing as shown in Fig. 6.

The lifting of damaged simple span proved to be much easier as it was lighter than the anchor span. However, there was a vertical twist with horizontal shift to overcome. The former was gradually levelled by giving two strokes on west side and allowing only one on east during jacking. The latter was corrected by working a pair of 100 ton jacks placed horizontally against the fixed pedestals of the adjacent span.

The whole work was carried out entirely with Railway construction equipments, materials and labor at an estimated cost of $58,600.00. It is possible that the cost may be reduced greatly if salvage values of timbers and sleepers are taken into consideration. This temporary repair was completed in 34 days from December 17, 1928, to January 19, 1929. The structure was opened to traffic on the following day and found to be quite satisfactory with negligible settlement.

The order for 60 tons of new structural steel parts @ G.$131.50 per ton and 10 tons of cast steel @ G.$171.50 per ton was placed recently with the original manufacturer in Germany. The permanent repair was pending until the arrival of new parts. It is believed that it will be finished before the end of June, 1929.

Personnels :—The design and construction of the work were under the direct supervision of Railway Engineers. H. T. Wu, Engineer-in-Chief; A. R. J. Hearne, District Engineer-in-Chief; the writer, Tsu Y. Chen, Engineer-in-Charge of the work; M. H. Koo, Y. P. Chu, C. L. Nei, L. H. Chow, Y. K. Sun, Assistant Engineers.



Pumping Engine Built by Worthington-Simpson, Limited, for the Waterworks of the City of Howrah, India

An American Equipped Pumping Station in India

FIFTEEN miles up the River Hoogly at Serampore is located the waterworks pumping station supplying the city of Howrah, on the left bank of the river opposite Calcutta, which is the center of the jute manufacturing industry in Bengal.

Since 1903 this municipality has been supplied with water by a Worthington horizontal triple expansion direct acting pumping engine. This unit is still giving good service, but with the need for added facilities the city engineers again turned to Worthington with their problems and last year purchased the vertical triple expansion unit which is shown here.

Details of this plant may be of interest to our readers. The steam cylinders measure 14 inches, 26 inches and 42 inches, respectively, in diameter; the pump plungers have a diameter of 17½ inches, and the stroke is 36 inches. At a speed of 39 r.p.m. this pump will deliver 3,500 Imperial gallons per minute against a total head of 200 feet. Steam is supplied at a pressure of 200 lbs. per square inch with 200 degrees F. superheat. Under these conditions the unit has a steam consumption of only 10.9 lbs. per indicated horsepower per hour.

This equipment was manufactured and supplied, with boiler and auxiliaries, by Worthington-Simpson, Limited, of London, whose works are located at Newark-on-Trent, England.

The 66,000 Volt Atami Power Cable

IN January, 1928, the Tokyo Electric Lghting Company, Ltd., Tokyo, Japan, laid a 66,000 volt cable at Atami, a place near Tokyo and famous among tourists as a summer and winter resort. The cable was manufactured entirely by the Japanese makers who took pride, well as they might, on the success achieved by production of the cable.

The installation and manufacture of this Atami cable is an epoch making event in the underground cable power transmission technique not only in Japan but in the whole Orient. The prominent feature of the cable is that it is for transmission of extra super-high voltage, and what makes its installation more praiseworthy is that all physical difficulties presented due to the steepness of the slope had been conquered. The elevation per 445 meters of the cable length was not less than 105.5 meter steep elevation. For this, an ordinary type of cable would have been unsuccessful, as the insulating compound with which the insulating paper is impregnated would be attended, in all probability, by gradual downflow of oil towards the lower elevation, when the cable becomes heated by the load it carries. With the oil-filled type cable, there would have been met also difficulties of high hydraulic pressure, approximately 10 kgs. per sq. c.m on the lead sheath. It was, therefore, apparently an adventure to adopt an oil-filled type of cable for the installation, but the difficulties were entirely surmounted, and the undertaking is crowned with success. To the Sumitomo Electric Wire & Cable Works, Ltd., Osaka, which manufactured and supplied the cable, we owe for the cable construction, and other characteristics of the cable and the factory test. Additional information is also given about the general trend in electrical industry where prevails a tendency for use of a still higher voltage cable, in fact, the underground cable transmission of as high as 154,000 volt is technically believed practicable.

Construction

The Atami cable is of single core, paper insulated lead covered and jute served type (Fig. 1) consisting of the construction as given below :—

Conductor :

Sectional area—250,000 cir. mils.

Construction—30 strands of annealed plain copper wire 2.32 mm. Diameter—16.24 mm.

Insulation :

Thickness—16.5 mm. 106 layers of paper, 0.15 mm. in thickness, was wrapped over the core every 6 layers in the alternative direction. 3 different papers, in thickness ranging from 25.4 mm. to 31.7 mm. in widths, was used.

Lead Sheath :

Thickness—3.3. mm. (total thickness).
Quality—Pure lead.

Jute Serving—Jute serving consisted of two layers, being 4.0 mm. Between the jute servings, for some lengths of the cable 2.0 mm. silicon bronze wire was wound whereas the other pieces reinforced with tinned hard drawn copper tape over the lead sheath, both for the purpose of mechanical reinforcement.

The cable reinforced with silicon bronze wire was laid in the higher part of the location and the cable reinforced with copper tape was laid down in the lower part of the slope.

Overall Diameter :

Cable with silicon bronze wire reinforcement : 65 mm.
Cable with hard drawn copper tape reinforcement :—65.4 mm.

Net Weight per Metre :

Cable with silicon bronze wire reinforcement :— 12.2 kgs.
Cable with hard drawn copper tape reinforcement :—13.1 ,,

Test piece was taken of each length of the cable and was submitted to a factory test before installation, which results were as follows :

Voltage Test.—Test pressure 100,000 volt a.c. was applied between conductor and lead sheath for 5 minutes, and results were satisfactory.

The test piece withstood the still higher pressure of 200,000 volt a.c. for 1 minute when the voltage was gradually increased, and also it withstood 280,000 volt a.c. without injury.

Another test piece was cut off the cable and was submitted to a bending test. The piece was bent to the 180 deg. around a cylinder having a diameter of 20 times that of the lead sheath; then it was straightened out ; bent again to 180 deg. in the opposite direction around the same cylinder, and again it was straightened out. This operation was performed twice in succession, and later the sample was again submitted to a test pressure and it withstood 240,000 volt a.c.

To test the joint two sample pieces of the cable were jointed and the pressure of 220,000 volt a.c. was applied for 3 minutes, and the joint proved safe against the pressure as high as that.

The out-door end box was also tested. The end boxes were provided with two arcing rings for the purpose of protection of insulator. Two out-door end boxes above described were connected by the cable of about 15 feet long for the testing purpose, and the distance of the two rings were adjusted to be 425 mm.

Then, the a.c. voltage was gradually applied between the terminals of the box and the earth. The arc-over was started directly between the two rings at 218,000 volt a.c. in the dry condition, and at 150,000 volt a.c. in the wet condition (Fig. 2).

After installation, the cable, itself, was tested by engineers of the Department of Communications, and the pressure of 79,000 volt a.c. was withstood for 1 minute between conductor and earth.

Power Factor of Charging Current of Dielectric—The power factor of charging current for the working voltage at 50°C. was about 1.5 per cent. and there was no indication

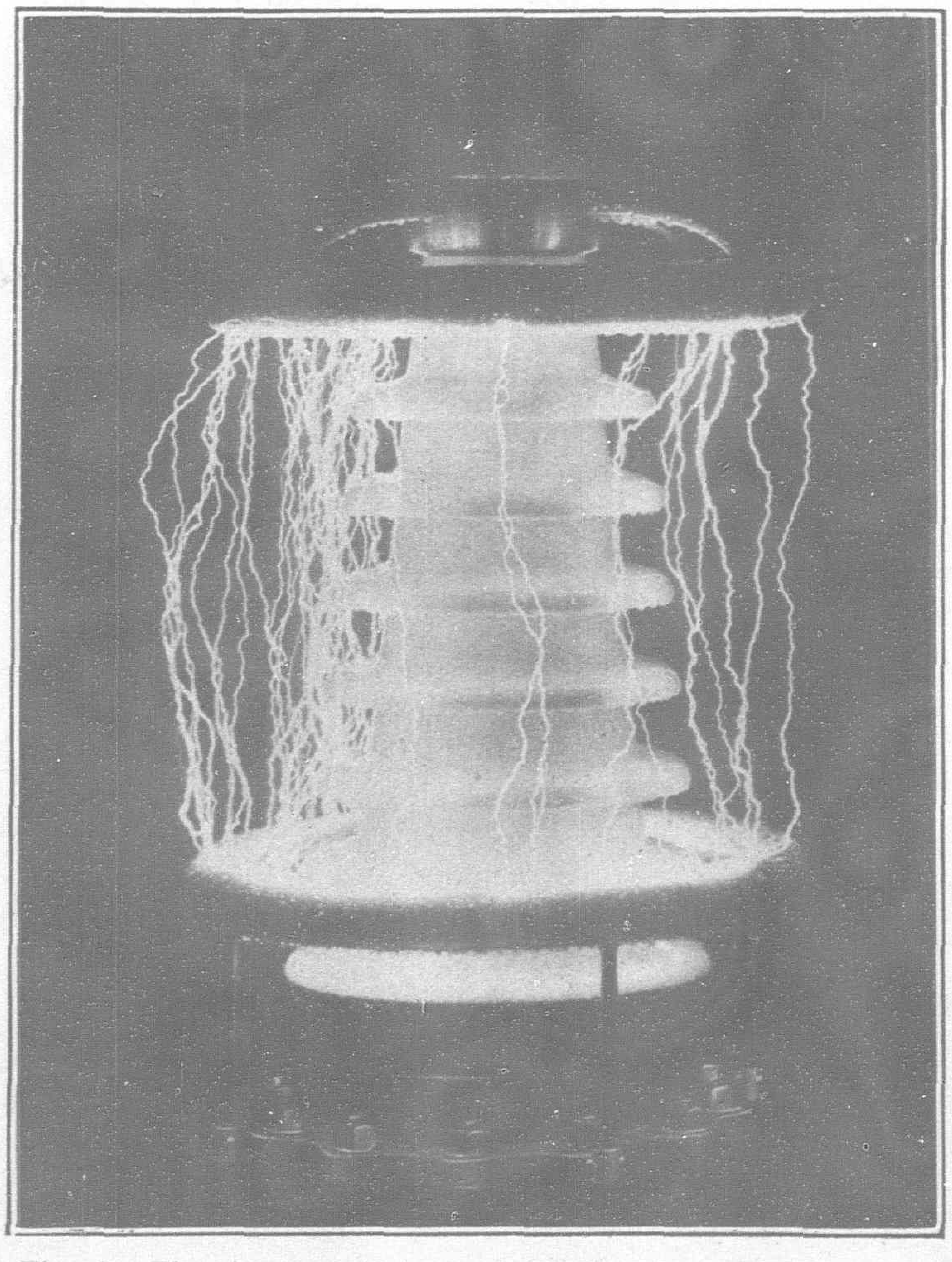


Fig. 2.—The Arc-over Between 2 Rings at 218,000 Volts, a.c.

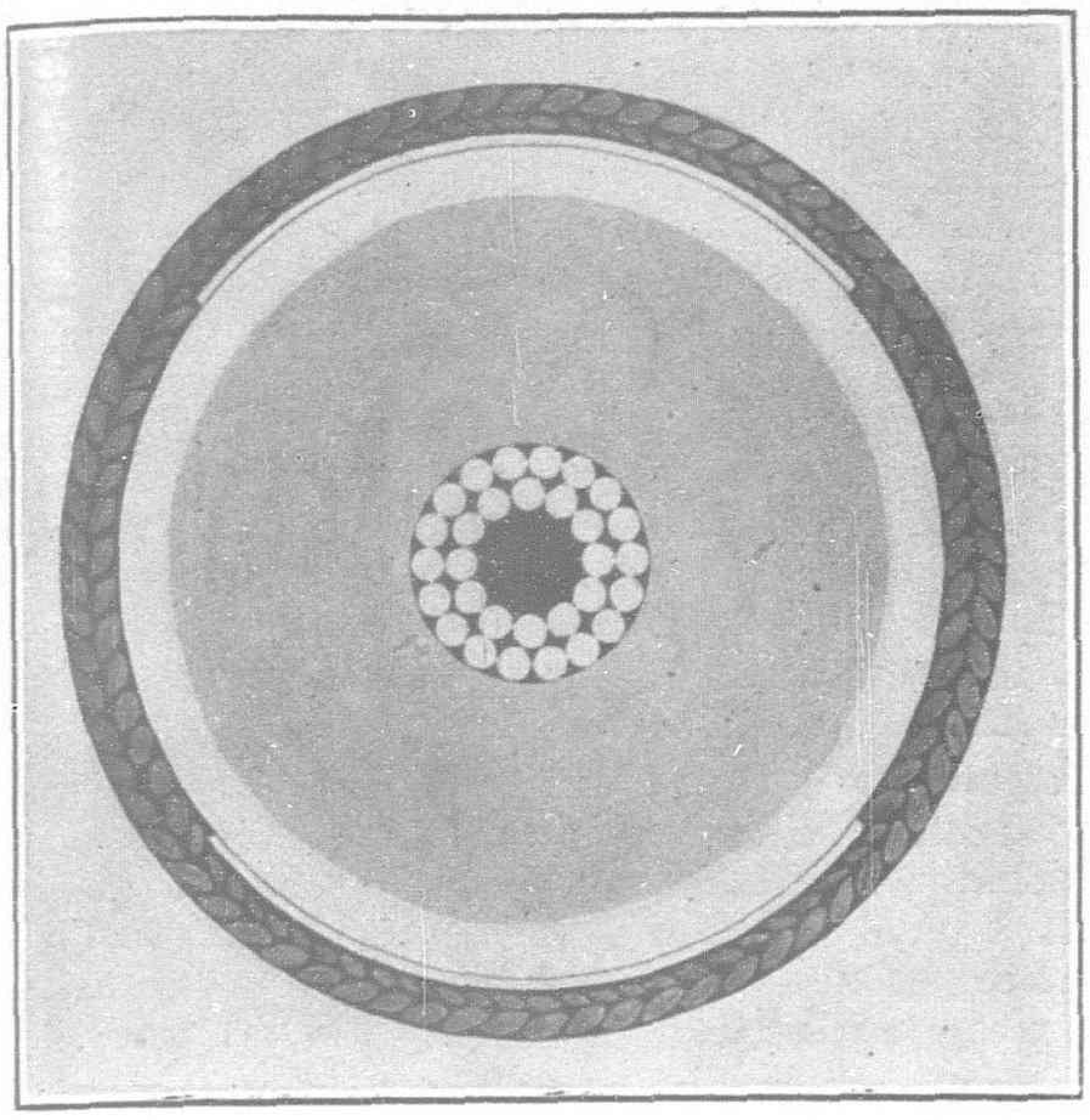


Fig. 1.—The Atami Cable is of a Single Wire

of any unreasonable increase in dielectric loss, when the pressure was increased from 40,000 to 100,000 volt a.c. at the room temperature.

Sheath Loss — The sheath loss in the lead cover which had been earthed at the ends and at the middle was 30 per cent. of that of conductor.

Three cable lengths were laid in parallel at the distance 0.5 ft. apart and two feet below the earth surface.

Current Carrying Capacity—The maximum safe limiting temperature of the cable was guaranteed to be 50°C. and the safe current carrying capacity to be 150 amperes (17,000 K.V.A.) under the continuous service.

At the test made after the installation, the temperature rise of conductor was found to be only 3.5°C at 100 amperes.

Characteristic of the Cables

1. High Density of Paper.—The dielectric strength or the breakdown voltage of the impregnated paper depends upon the density of paper itslelf. This is deduced directly from the fact that the breakdown voltage of the impregnated paper is much higher than that of the insulating oil, that is to say, where the dielectric is composed of both insulating oil and paper, the paper serves to prevent move of the "' Ion." Mr. Emanueli, the Societa Italiana Pirelli, Italy, made a study quantitatively on this subject and published his results which are given in Fig. 3. The term "density" mentioned herein refers to the porosity of the paper. The porosity is measured in accordance with the time taken by a certain volume of air to permeate through a unit dimension of paper at a certain pressure. The paper of possibly highest density is preferable for the super high-tension cable. But in the density of paper, there must be a limit because beyond a certain limit there will be attended by difficulties in the course of impregnation. The paper used for the 66,000 volt cable was made of wood-pulp fibre, and its density was measured by the Gurly Densometer, showing the result of 1,800 seconds. When it is compared with the ordinary manila paper, there is appreciated the superior quality of the paper used for the present cable. For an ordinary low-tension cable, a manila paper is used with its density test on the Densometer is about 100 seconds or less. The higher the density the more difficult will be impregnating work. In the Atami cable, impregnation was applied twice, dividing the work into two processes, in order to make the impregnation complete. The impregnation was found entirely satisfactory, as shown under the power factor test, which was made at a pressure higher than that of working.

2. Oil Filled Type.—The location where the cables were installed is situate on the hillside at the rear of the Tokyo Electric Lighting Co.'s Atami Substation. Its average sloping is about 27° and the maximum, 31°. In the actual elevation, as mentioned above, the vertical height was 105.5 meters for the whole cable length of 445 meters. In the course of its service, consequently, the insulating oil would gradually flow down toward the lower part of the cable, causing a shortage of oil between the layers of insulating paper at the upper part, and an increased pressure would be caused at the lower part, of the cable. This down-flow of insulating oil is unavoidable in the cable where the insulating oil used is of the ordinary viscosity. For a long time, experiments had been conducted at the works to assertain the pressure due to the head, and this oil migration, and the sufficient data were obtained to determine the pressures that would be created by the different heads and to which the cables would be possibly subjected. In a low-tension or an ordinary high-tension cable, such as used in vertical colliery, the shortage of oil may not cause the breakdown of the cable, but in a high-tension cable of such a high voltage as 66,000 volts, ionization would often occur resulting in the breakdown of the cable.

In order to prevent the breakdown, there was provided an oil tank at the top of the cable, so that the oil shrinkage would be replenished. The change of the load on the cable or the variation of temperature of the earth, or both, cause the rise and fall of the temperature within the cable .

When the temperature rises, both insulating oil and lead expand, but their coefficients of volume expansion differ, that of insulating oil being approximately 0.0007, and that of lead being 0.000088. The oil inside the cable, would, therefore, cause expansion of the lead sheath. On the contrary, when the temperature falls after the expansion, there occurs an empty space within the cable, as lead is non-elastic and does not contract into its former state. The breakdown of a cable by electric pressure is more often due to lighter-loading which takes place soon after overloading. Whatever care and caution be expended in manufacture, it is difficult, in an ordinary type of the power cable, to prevent this occurrence of breakdown.

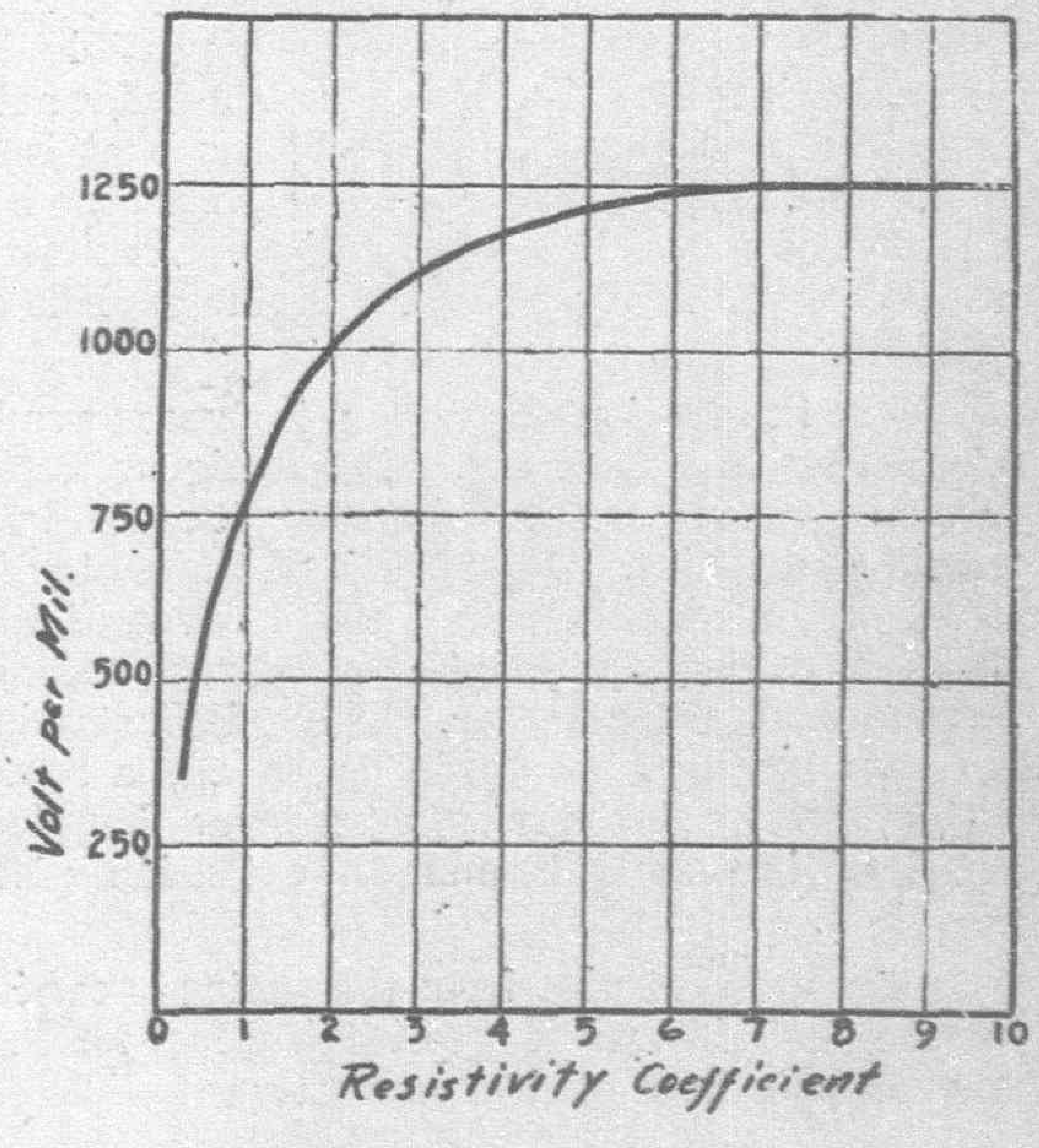
It becomes needful to provide a means for supplying oil from the outside by some adequate method, so that the emptied space may be instantly and constantly filled up with oil.

In order to meet with requirement, there was adopted a hollow conductor which will facilitate flow of the insulating oil, and there were also provided some oil tanks placed at both the ends of cable that will serve for the constant supply of oil. This kind of type is known under the name of the "oil-filled type" cable. Its typical example is the 132,000 volt cable which was manufactured under the Pirelli's patent, and was installed some where in New York and Chicago, U.S.A. a few years ago. The oil for this New York and Chicago cable was of much lighter viscosity, similar in some degrees, to transformer oil, than the oil which was used in the Atami cable. The oil for the Atami cable had the viscosity of 10.0 at 100°C according to the Englar's viscosmeter. The oil tank adopted for this 132,000 volt cable was so constructed that a sufficient pressure might be maintained to facilitate the flow of oil in all the part of the cable. The oil was well refined, and possessed a super-electrical quality.

Strictly speaking, therefore, the Atami cable, might be said that it was a cable classified to be midway between the oil-filled type and the ordinary type of cable.

3. Hollow Conductor.—With it in view to follow some of oil-filled type system features and to make the impregnation complete, there was in the Atami cable adopted the hollow type conductor. There are many kinds of constructions in the hollow line of conductors. The typical one is that of the Pirelli's 132,000 volt cable, mentioned above, where copper tapes of a slightly arched shape are wound into an open helix, outside of which annealed bare copper wires, having depressions here and there, are stranded for the first layer of stranding.

This hollow type would be a suitable type for an ordinary installation to enlarge the oil path, to diminish the resistance, facilitating the oil supplying to the cable insulation. Inspite of relatively smaller hollowness in the conductor, the topographical condition of the



location, at Atami, made easy oil supply from the oil tank which was placed at the highest end of the cable. The simplest form of construction was therefore adopted. The conductor was composed of annealed bare copper cable, having the hollow dia. 6.96 mm., without inner support and being stranded with 12 wires, at the pitch of 12 times the pitch dia., for the inner layer, and 18 wires, at the pitch of 13 times the pitch dia., for the outer layer. Prior to the application, it was ascertained by factory tests that the shape of this form of conductor would not be injured even by bending and would stand safe in operation in the service.

4. Reinforced Lead Sheath.—In the course of its service, the cable will be constantly subjected to the oil pressure. At the bottom of cable the pressure due to head would be above 10 kgs per sq. cm. when the temperature would rise rapidly, and either when the load should be increased rapidly or when the temperature of earth should rapidly rise, the pressure would increase to a much higher figure than above stated. This fact was ascertained through repeated experiments performed at the works. Although the lead sheath might be made somewhat thicker for the purpose of protection against this pressure, this would be of little avail. Twin silicon bronze wires, 2.0 mm. dia., was, therefore, helically wound around the lead sheath at the pitch of 15 mm. for the pieces of cables which were installed at the upper side of the hill where the cable might be subjected to a comparatively lower pressure. The portion of cable for the lower place installation where there was possibilities of its being subjected to a higher pressure, tinned twin hard drawn copper tapes, 12 mm. in width and of 0.8 mm. in thickness, were applied helically around the lead sheath at the pitch of 15.5 mm. Over this reinforcement device the tarred jute yarn was served. According to the test results of these two types of reinforced cables, the former lead sheath slightly changed its shape at the pressure of 12 kg. per sq. cm. but the latter did not show any sign of deformation in lead sheath even at the pressure of 20 kgs. per sq. cm. By experiments, it is known that pure lead is broken at the pressure of about 140 kgs per sq. cm. A non-elastic body as it is, lead has no elastic limit. It has more of characteristic of a liquid of high viscosity rather than of ordinary metal. Consequently, when it once expanded even at a much lower pressure than that of the breakdown, lead will never restore its former state. The New York and Chicago 132,000 volt cable was first wound with twin hard drawn bare copper tapes around the lead sheath, and the cable was leadsheathed again overall. The second sheathing was for the purpose of making the surface of the cable smooth in order to facilitate pulling the cable into ducts, and also to prevent the corrosion of copper tape, which may occur through chemical actions when copper tape is left in the earth for a long period of time. It is also of a great necessity in this sort of a long cable for the sake of protection against defects or against mechanical injuries which may occur in the course of lead sheathing or in the course of transportation.

5. Oil Tank.—Oil tanks installed at Atami were two kinds; one being oil reservoir and the other, pressure tank. The tank which was located with the upper terminal box takes care of oil supply to the cable through the advantage of its sufficiently higher position and a tank which was located with the lower terminal box, must be, therefore, necessarily so constructed as to withstand the heaviest oil pressure to which the cable is to be subjected.

This was why the makers had recourse to the oil reservoir for the former and the pressure tank for the latter. The oil reservoir has the graduations and a pressure gauge for the purpose of measuring the oil volume. The pressure tank is equipped with a pressure gauge, and also with a relief valve in precaution for heavy pressure which might be brought about temporarily by the down-flow of insulating oil. This valve was constructed to let the oil flow out when the pressure reaches 13 kgs per sq. cm. and to shut automatically when the pressure falls to 11 kgs.

These tanks were submitted to the test pressure corresponding to 150 per cent. of their respective maximum oil pressure under actual service; the oil reservoir for the top end to the pressure of 5.5 kgs per sq. cm. and the one for the middle, to 7.5. kgs, and the pressure tank for the bottom, to 16 kgs, for 30 minutes respectively.

An Auxiliary Built in Hongkong

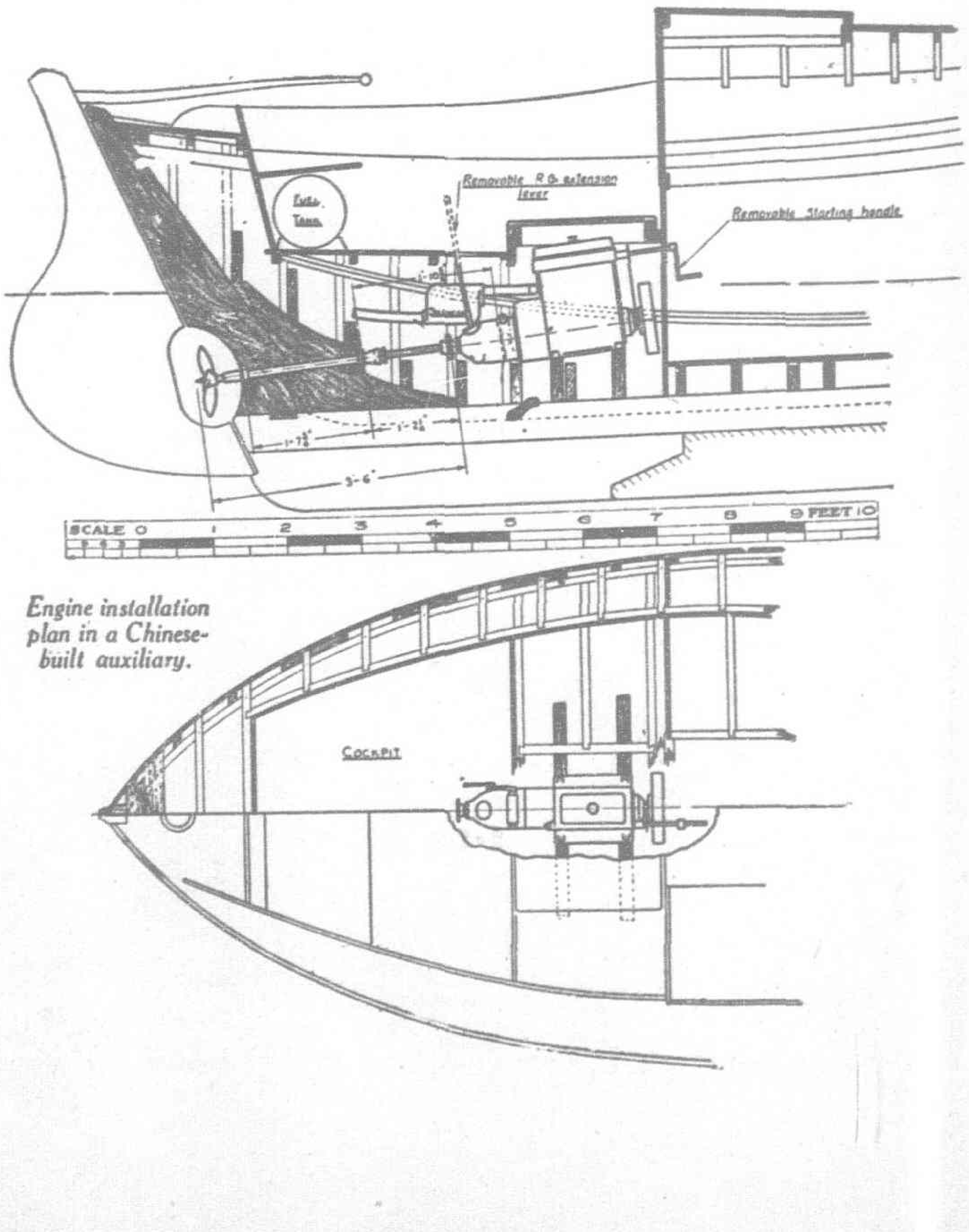
Chinese-built, British-engined Craft for Japanese Waters

At least four different countries happen to be interested in the construction of the double-ended auxiliary craft of which the engine installation is illustrated herewith. In the first place, the motor is a British-built production; secondly, the design is from the board of an American naval architect, while a third feature of interest is that the hull is under construction at Hongkong, thereby bringing China in to the picutre. As the craft is specially intended for use in Japanese waters a fourth element is introduced.

No particulars are to hand regarding the woods to be incorporated in the hull or we might very possibly draw one or two more countries into the list, but from the information to hand we are able to remark that the length of the boat is 21 ft. and the beam 6 ft. 6 ins. As the owner proposes to use the boat mostly for sailing the area of canvas is 280 square feet. At the same time it is desired to have as auxiliary power an engine capable of steady running on paraffin.

The illustration shows how the space available will be utilized. Consisting of a 7-12 h.p. Ailsa Craig unit, the engine occupies a position under a self-draining cockpit aft and rests on bearers which run athwartships. As the top of the motor is slightly above the level of the cockpit floor a raised cover of stout construction has been provided, and this, when removed, gives access to the engine and reverse gear. The raised starting shaft is extended to pass through the cabin bulkhead, a removable handle being fitted, while the reverse gear lever handle is below the floor level of the cockpit and an extension piece is shipped when required.

The exhaust pipe from the engine is carried to a silencer fitted on the port side, while a cylindrical fuel tank rests on chocks below the cockpit seat, which runs athwartships. The motor drives a three-bladed propeller, which turns in an aperture formed partly in the sternpost and partly in the rudder.


Fuel Tank
Removable R.G. extension lever
Removable Starting handle
1'-7¾"
1'-2⅜"
3'-6"
SCALE 0 1 2 3 4 5 6 7 8 9 FEET 10
Cockpit

Engine installation plan in a Chinese-built auxiliary.

Chinese Bridges

By H. F. Meyer, M. Danish Soc. C. E. Assoc. M. Am. Soc.

The Following are Excerpts from a Paper which was Read before the Engineering Society of China

ALL Chinese bridges are built for light traffic. Roads, in our sense of the word, do not exist in China except near centres under foreign or semi-foreign influence. There is therefore never any question of heavy vehicles loading up the structures; human loads of about 75 lbs.-sq. ft. would be the highest loading ever encountered. The width of the structures can therefore practically be made as small as stability allows; bridges where two persons can hardly pass each other are not uncommon. The very narrow Chinese roads and streets also serve to discourage bridge builders from making their structures broad and comfortable. Stone steps lead up to the top platform at the middle of the structure. In the river provinces, intersected by the many smaller and bigger streams, the inaccessibility of the bridges has once and for all set a stop to any development of any type of vehicle except the light wheelbarrow which can easily be carried over the bridge.

We will now examine the various types of bridges and divide them in the following classes:

(1) Wooden bridges
(2) Stone bridges, slab type
(3) ,, ,, arch ,,
(4) Combined stone and wooden structures
(5) Suspension bridges

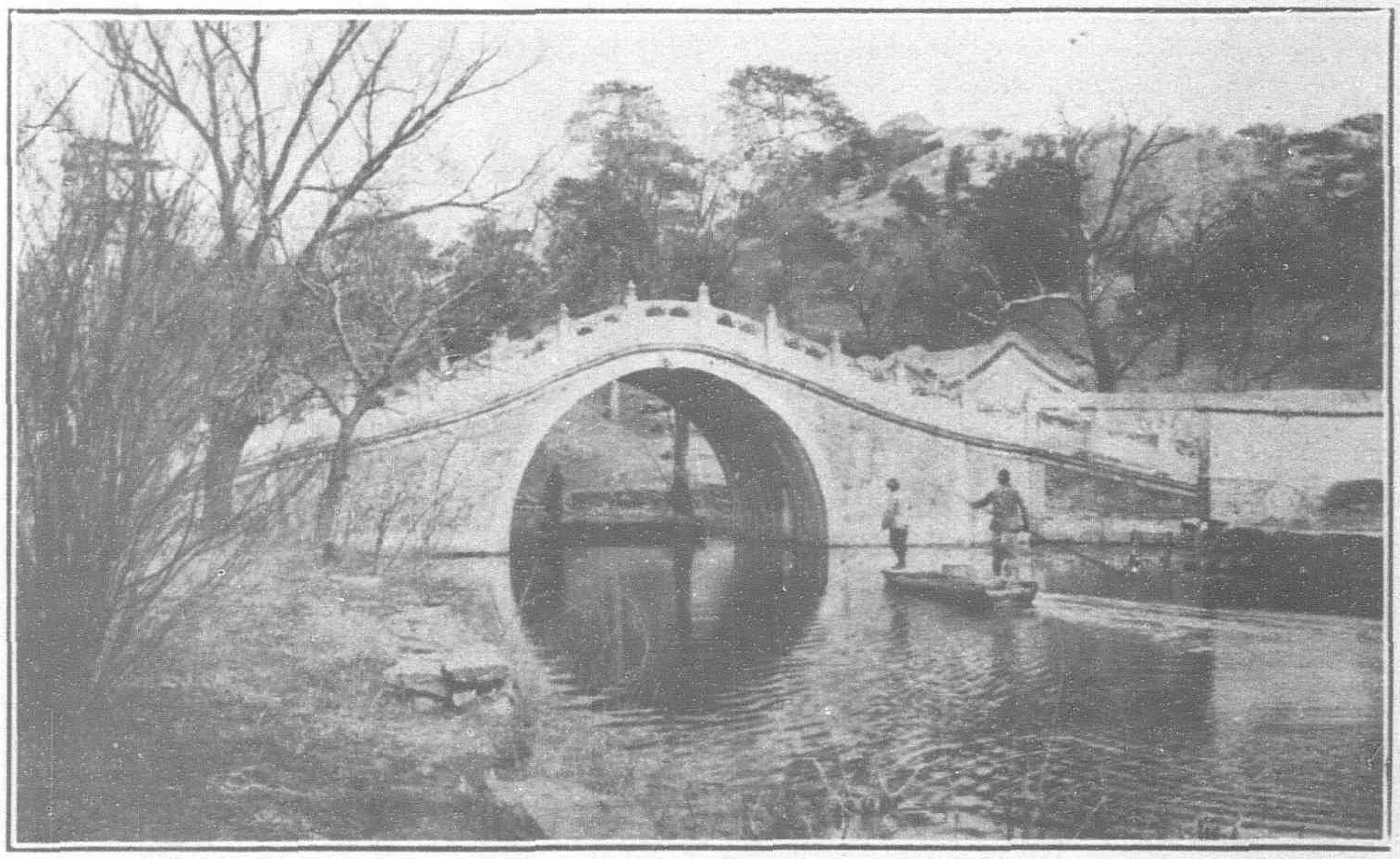
Wooden Bridges

In all countries where boats are known, pontoon-bridges will occasionally be built. In many parts of China these are found.

They consist of a number of old flat sampans anchored in a line across the stream, all parallel to the shore, and a wooden bridge, generally made of round poles spanning from boat to boat, covered with 1½-in. planks parallel to the direction of the stream.

If the channel the bridges spans is navigable it is discontinued in one or two places, the gaps being spanned by a few loose planks which must be removed and replaced by the boatmen desirous of getting through.

In some instances specially high poontons are built so as to permit the traffic on the waterway to pass under them unobstructed.



Bow Bridge, Peiping (Peking)

Over some of the shallow turbulent mountain streams in the province of Szechuen wooden bridges of a similar description are built, but instead of boats the supports consist of large stone filled bamboo baskets. Each single span is generally about 20-ft.

The simple type of wooden bridge as found so often in the Kiangsu and Chekiang provinces is exactly the same as those seen on the oldest Chinese pictures. *Fig. 2* gives an idea of the dimensions of a fairly big one near Chingpu. It is supported on Foochow poles driven only 5 to 6-ft. into the muddy creek bottom by means of the usual kind of hand manipulated stone rammers. The ramming will be done by six or eight coolies rigged up on the pile itself, adding their own weight to the downward tending forces. The deck is made by long slender round fir stems placed side by side from support to support, on top of which a layer of smaller branches is fastened. The surface is covered with a thin coat of mud making the surface smooth and pleasant for bare footed pedestrians.

Such a bridge will stand for two to six years. The wood deteriorates quickly in the humid and warm climate—repairs are never made until the bridge is either so unsafe that no one dares to cross, or until it collapses—first then a total rebuilding is considered.

Stone Slab Bridges

Stone Slab Bridges form the next step in the bridge development; they are as a whole copies of the wooden bridges only made in another material, and therefore bound to be constructively unsatisfactory. They do not utilize the high compressive strength of the stone but entirely depend on its very unreliable bending resistance.

Fig. 3 shows an ordinary small stone bridge, the stones are mortised into each other like wooden planks; no mortar is used; sometimes double wedges of steel connect the deck stones.

Next to the wooden, this type of bridge is the cheapest, and it is very frequently met with. The manufacture of long stones used as units in the construction is an industry in itself; all over in the river delta where a hill of suitable material lifts its rounded profile above the muddy flat the clanging of stone hammers will be heard turning out this kind of stone.

A number of different standard sizes are turned out in these quarries; they heap up a large quantity of them and ship them to towns and villages where smaller stores are kept by local stone cutters.

The stone cutter's profession is just as well known and needed for the upkeep of the countless thousands of bridges as the carpenters for house building.

The widths of the stones vary very much, but most frequently the shorter ordinary ones are about 14-in. wide. For the very long and thick stones the width is generally greater than the thickness.

A very unimportant little country bridge may only be one stone wide, but bridges over an important creek or canal are seldom less than three to four stones wide; the nearer they are to an important town the wider they will generally be.

On top of the foundation stones for piers and abutments a stone parallel to the creek is placed, into this vertical stones (same number as in the deck) are mortised, on top they are again mortised into another stone perpendicular to the span, on which the deck is supported. The narrow piers afford a minimum obstruction in the creek.

For larger spans the piers and ramps are built up in a more massive way, sometimes very strongly tapering, being several feet broad at the base and only one or two feet at the top; some-

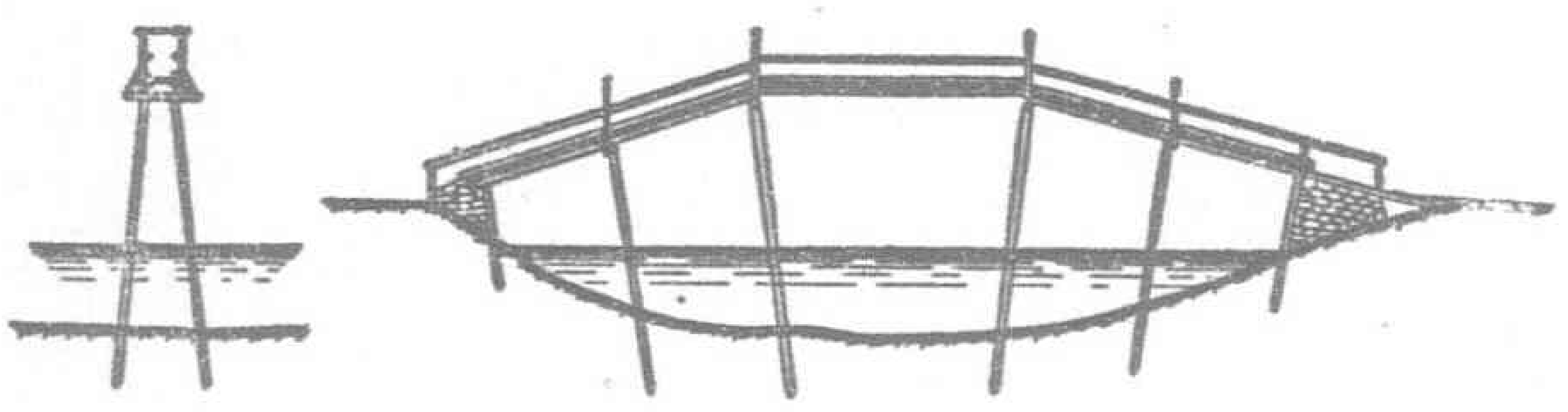


Fig. 2.—Wooden Bridge at Ching Pu

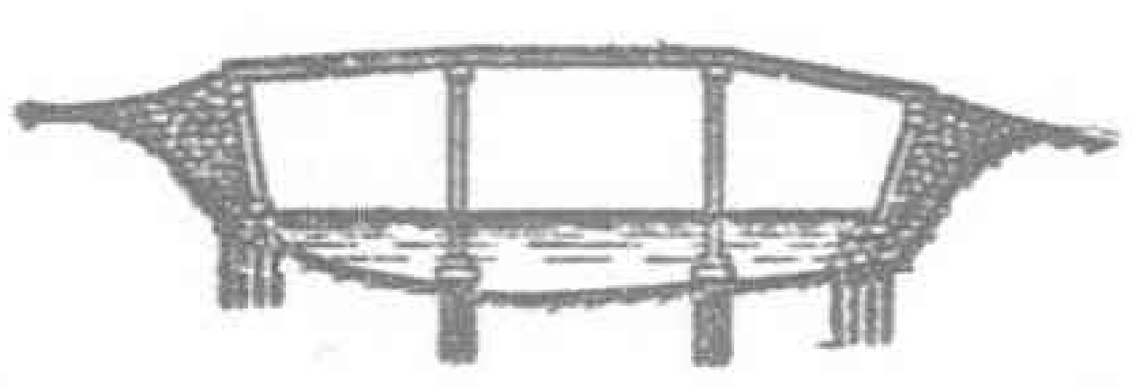


Fig. 3.—Ordinary Stone Slab Bridge

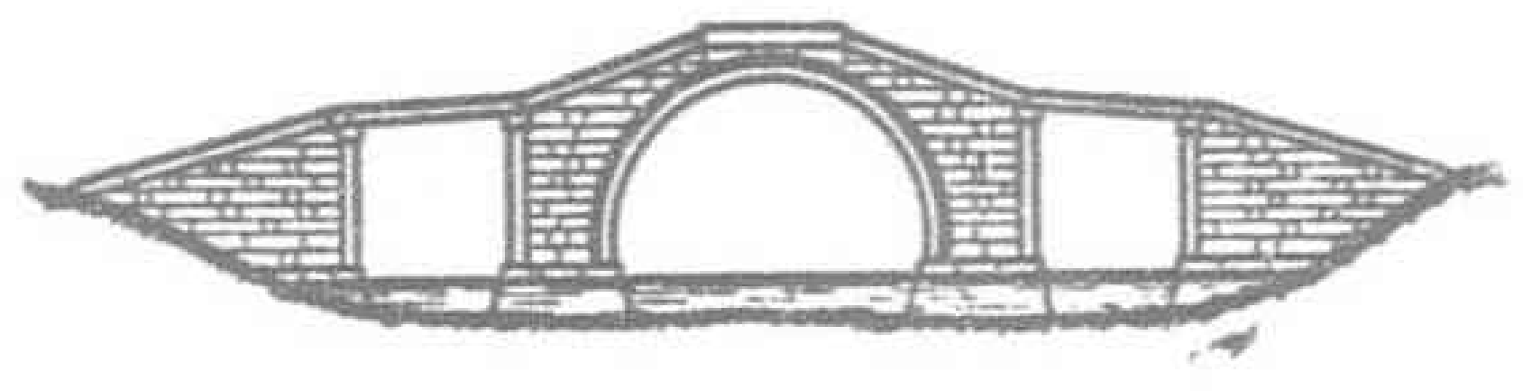


Fig. 4.—Bridge at Grand Canal

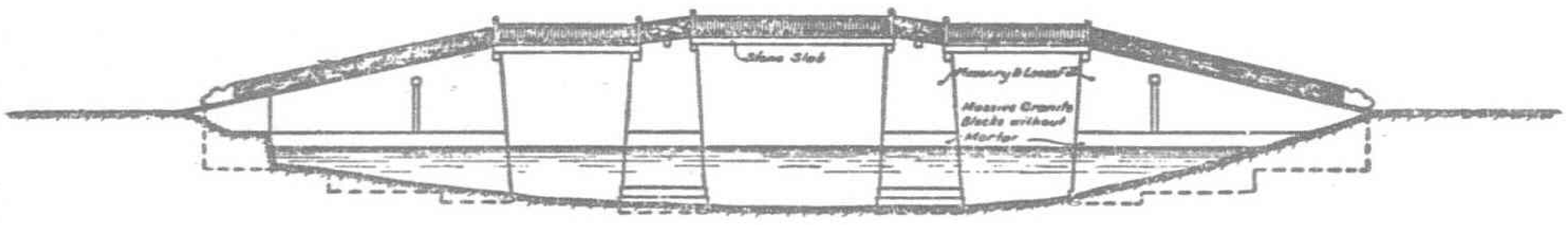


Fig. 5.—Stone Slab Bridge at Soochow

Fig. 1.—Has been Omitted from this Article. It is the Chinese Character for Bridge

times the piers are heavy and rigid such as the bridge near Soochow shown on *Fig. 5* (built ten years ago).

The maximum tension in the bridge slab as shown on *Fig. 5* is about 900-lbs. per sq. inch; without any superimposed load the stress is still as high as 670-lbs. per sq. inch.

The stone slab type of bridge is predominant in South-China where the arch type rarely is used. Near the wealthy commercial centres on the coast of Fukien some marvellously large structures can be seen. At Tsienchowfu a bridge, dating from the Sung dynasty (1000 A.D.) spans a wide navigable stream. It was built under the supervision of the local governor and is called "the ferry place of 10,000 times peace" denoting that the structure substitutes an ancient ferry service. It is 3,780-ft. long, 16-ft. wide and has 47 spans. The piers are rectangular heavy blocks built up with square stones; some of them have sunk a few feet giving the bridge a very uneven appearance. About midway a heavy gate tower guards the bridge.

In Changchowfu two similar ancient bridges about 2,000-ft. from each other have recently been rebuilt, by taking off the stone slabs and the old stone railings and building a deck of reinforced concrete beams and slabs on the old piers. The one bridge is called "Old Bridge" and the other "New Bridge." Both of them are built to curve against the strong currents of the Shao river; the heavy stone piers are boat-shaped. The greatest single span in any of them is 40-ft.—the old stone slabs, now replaced, were 3-ft. by 3-ft. and the width of the bridges about 16-ft.

A marvellous giant stone slab bridge can be seen 20 miles from Amoy up the Dragon River; it is 1,100-ft. long and some of the spans are 70-ft. made of stones 5-ft. thick and 6-ft. wide, the deck is 14 to 16-ft. wide. Such slabs would weigh 200 tons; it is still a riddle how these enormous stones were lifted in place and the mountains in the neighborhood do not indicate from where they were brought. The tensile stress in the slab would also here be 900-lb. per sq. inch. If entirely without superimposed load it is 820-lbs. per sq. inch. *Fig. 14* shows a few of the spans of this bridge and the boat shaped piers, and also an old two storied toll-house at the middle of the structure. The bridge is in decay, the stone handrailing is much delapidated and not in such good shape as shown on the Figure.

At Foochow a long bridge named "Bridge of 10,000 Ages" connects the city with "Middle Island" in the river. The structure is 1,270-ft. long, 14½-ft. wide, it has 35 piers and was completed as late as 1323; another shorter bridge leads from the island to the other bank of the river.

In pleasure gardens, canals and miniature lakes are generally created; there long stone slab bridges of small spans form the chief decoration, they are mostly surmounted by pavilions of so elaborate a character that they nearly lose their appearance of bridges.

The ordinary stone slab bridge is an economical and durable type, if not overloaded; but it is unsatisfactory technically and it often happens that such a bridge falls, blocking a creek for months.

Stone Bridge Arch Type

The Chinese arch bridge may not appear so singularly marvellous at the first glance, as so many arch structures both older and larger are found where the older civilizations have grown in western Asia and southern Europe. But considering that we are here facing the only structures in this country which can truly boast of some antiquity they become interesting. The aims of the official building art of China have always been to create the greatest impression at the smallest expense; permanence has never been aimed at. Poor materials, slender dimensions and childish designs carried (and still carry) the surface splendor of palaces, temples and yamens, but the stone bridge and more especially the arch construction, if built strongly enough to carry its own weight, could stand the wear of centuries and the usual Chinese neglect of upkeep.

The principle of an arch bridge is the same all over China, wherever they are found and however different they may appear. A thin shell of granite spanning from one rigid support to another carries the remainder of the construction. The axis of the arch is always perpendicular to the bridge—a skew arch has never come to the author s notice.

Fig. 4 shows details of a bridge from the Kiangsu Province near Soochow. The foundation rests on clay and is therefore carried by a number of slender pine piles.

On top of the piles heavy stone foundations without mortar connection are made. Between these foundations the main arch is built up; it consists of long narrow curved stones placed side by side parallel to the direction of the pressure, intersected by straight stones into which they are mortised; these stones are parallel to the axis and have the same length as the width of the bridge. If one of the curved stones should be damaged (which sometimes happens) it can fall out without threatening the whole structure.

Parapet walls of granite, often laid in mortar, with a certain number of dove-tailed stones in between for the sake of connection, are erected on the granite foundation and a fill of clay and stone chips is placed between the parapet walls and the arch; the surface of the fill is covered by granite steps and on the upper flat middle platform by a big carved granite slab.

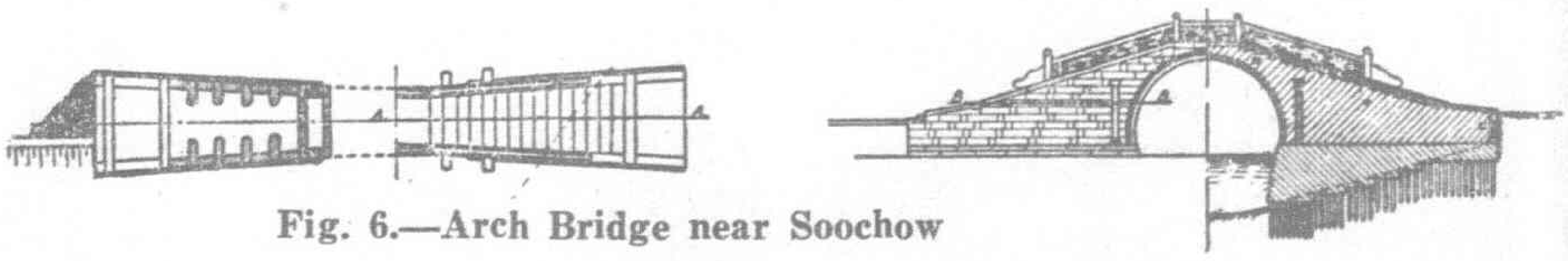


Fig. 6.—Arch Bridge near Soochow

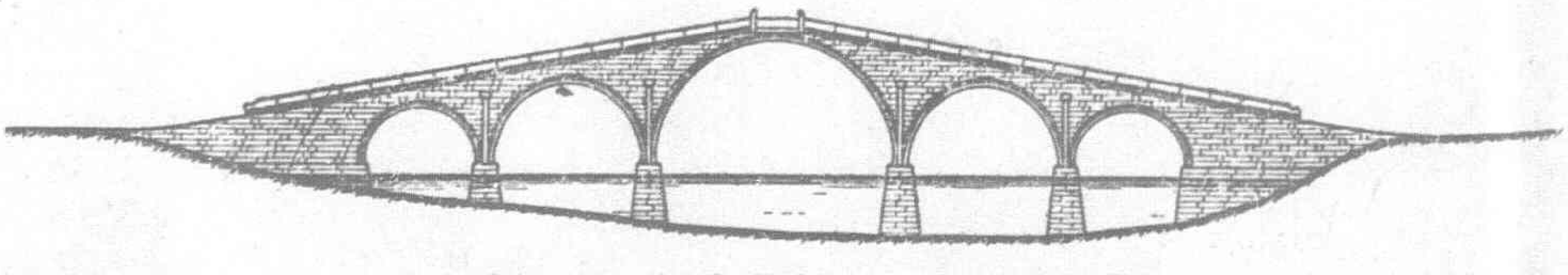


Fig. 7.—Arch Bridge near Ching Pu

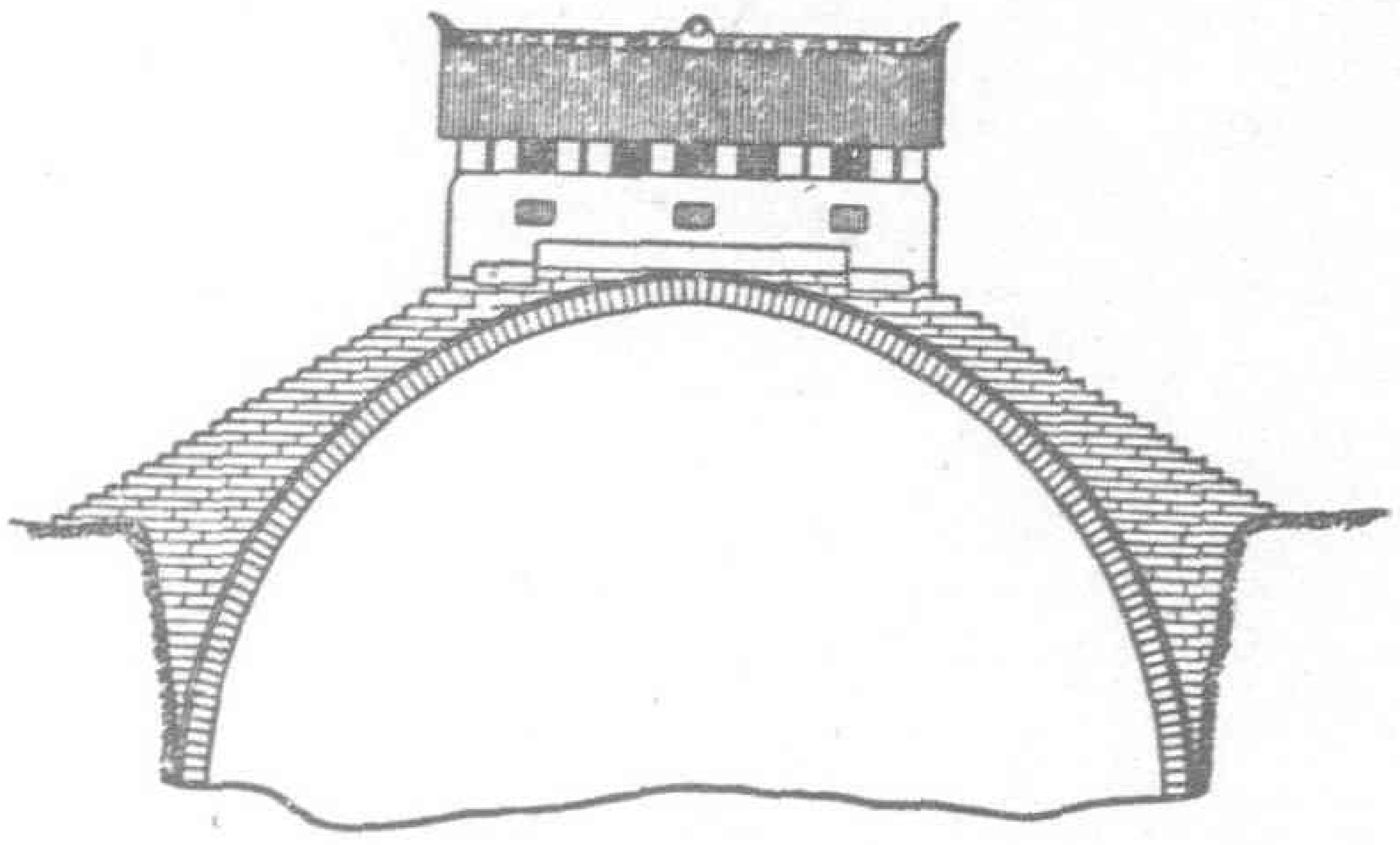


Fig. 8.—Wan Hsien Bridge, Szechuen

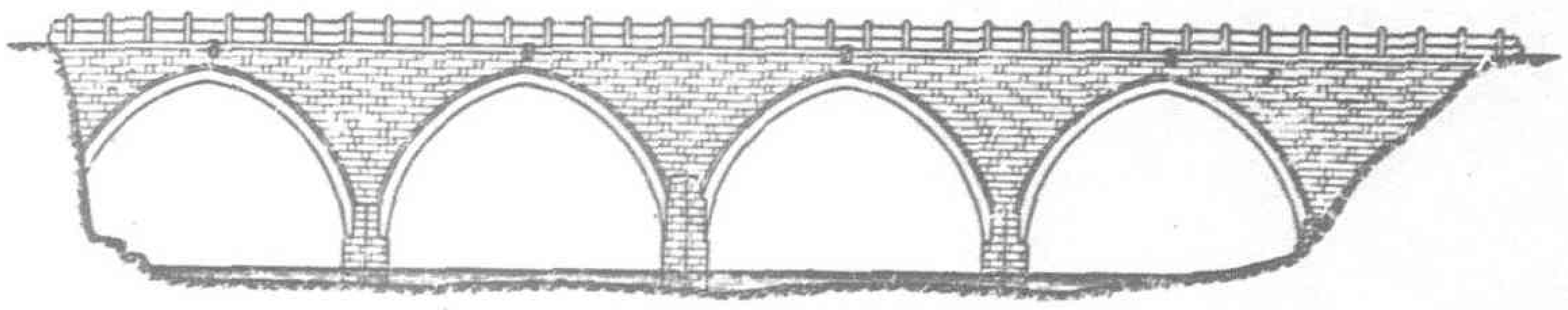


Fig. 9.—Arch Bridge Yachowfu, Szechuen

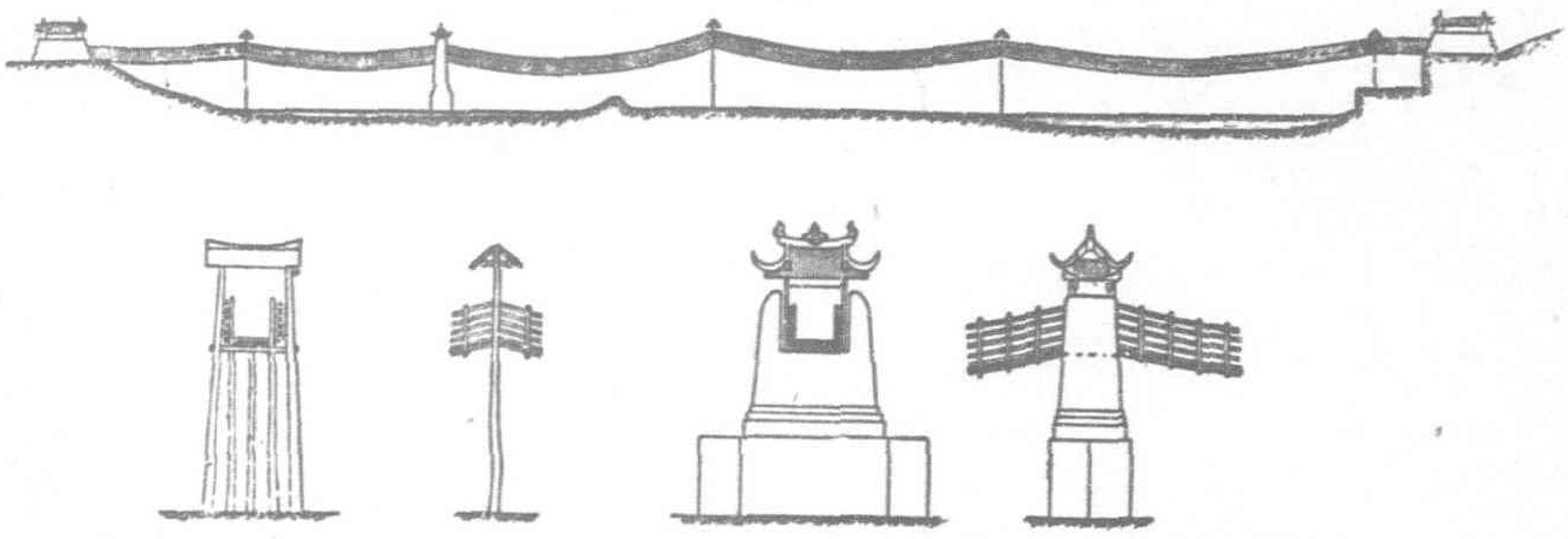


Fig. 10.—Bamboo Suspension Bridge, Kuan Hsien, Szechuen

A vertical stone wall is placed just behind the arch, it consists of long stones mortised into the massive granite blocks below and into a long horizontal stone on top running out through the parapet walls on both sides. This "shear wall" is an essential part of the structure; it prevents uneven settlements in the fill behind the arch and possible bending moments in the arch will through the fill be transferred to the wall. In the cheaper structures it is missing, and their life will therefore generally be short; as years pass and the foundation settles and the load changes, the arch will come out of shape and finally collapse.

In larger bridges with several spans a shear wall generally is made between every arch. They are very much needed because the centre of the arch is always above the base.

A well built arch in the lower Yangtze Valley is always perfectly circular, but a large number of them are flatter than a circle on account of the weak centerings used. Such a centering usually consist of a large number of vertical bamboos, five or six inches in diameter interconnected by horizontal bamboos crosswise and lengthwise, all connections made by bamboo fibres tied on while wet.

The vertical bamboos rest on stones or planks on the creek bottom. The whole scaffolding as elastic and has a tendency to deflect strongly and sink under the load of the arch stones.

The structures in northern and western China seldom have any shear wall. The arches there are only rarely "over curved." In the West the fill is less cohesive and not so apt to give way to pressure and in the North three heavy binder stones connecting the parapet walls substitute the shear wall (see *Fig. 12*). *Figs. 8* and *9* show two typical examples of Western Chinese pointed arches. *Fig. 8* remarkable for its daring slenderness; there is no mortar used in it; the arch is built up by smaller blocks and loaded with big heavy blocks; a flight of steps is cut in the blocks up to the toll station on top. The maximum pressure in the arch is only 600 lbs. per sq. inch.

Some of the newest and most glorious arch bridges are found near the Summer Palace over the artificial lake made under the reign of the Empress Dowager Tzu Hsi. *Fig. 13* shows a "camel back" bridge from there; it is built of white marble. Another famous curved bridge with 13 arches leads from the shore out to the pleasure grounds of a small island in the same lake.

In the journal of Association of Chinese and American Engineers 1924 a photograph of a very remarkable bridge is found. It shows an arch bridge of 100-ft. span. The main arch is quite flat, only 17-ft. higher in the middle than at the abutments; the road on top is nearly horizontal, carried by a number of smaller arches supported on the main arch. The whole structure looks like a modern European bridge. Below the photograph it is stated that the name of the bridge is "big stone bridge" and that it is found in Chao Hsien, Chihli, and was built by Li Chin during the Sui Dynasty about 600 A.D. The big 100-ft. arch is made of stone with mortar joints and iron keys in the way the Chinese use to build bundings. I personally doubt that such a wonderfully daring idea should have been allowed to be tested under an unimportant little struggling dynasty like the Sui; even the use of mortar combined with iron keys would make anyone suspicious.

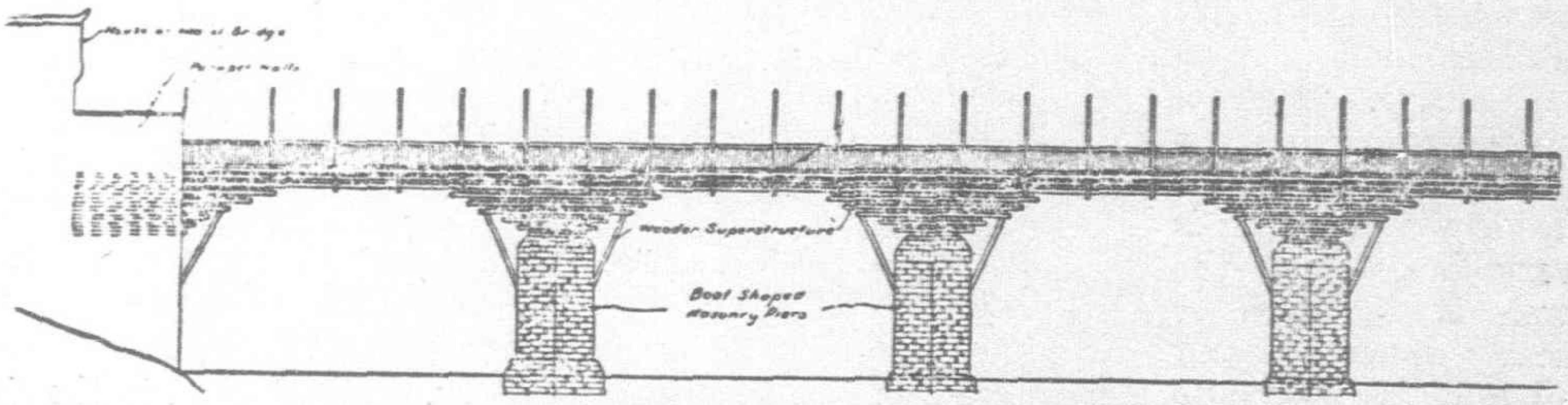


Fig. 11.—Cantilever Construction, Liling Hsien, Hunan

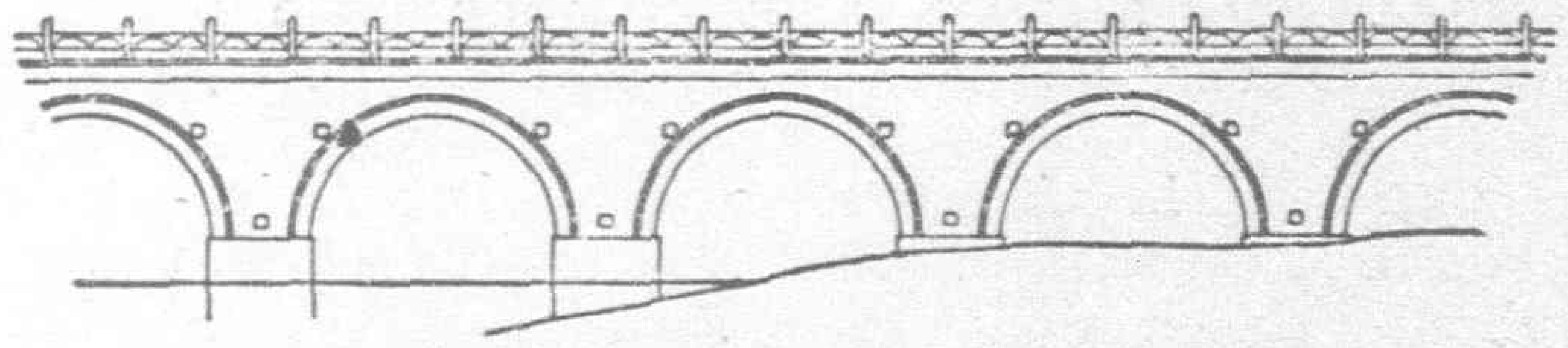


Fig. 12.—Spans of Bridge, Yenchowfu, Shantung

0 80

General Scale Feet

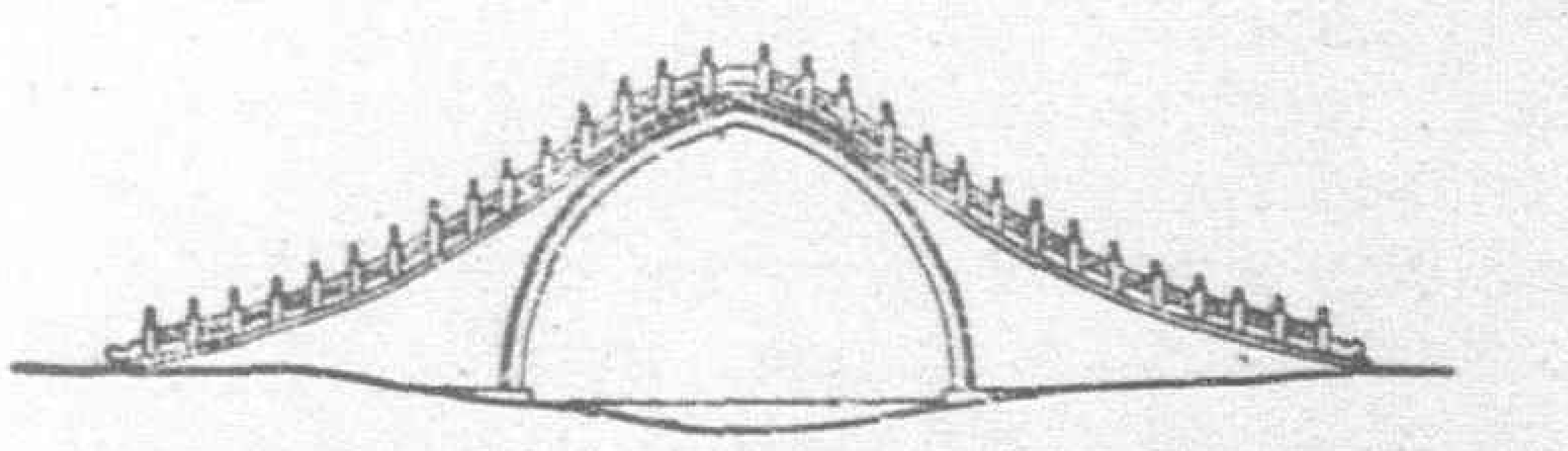


Fig. 13.—Marble Bridge, Summer Palace Chihl

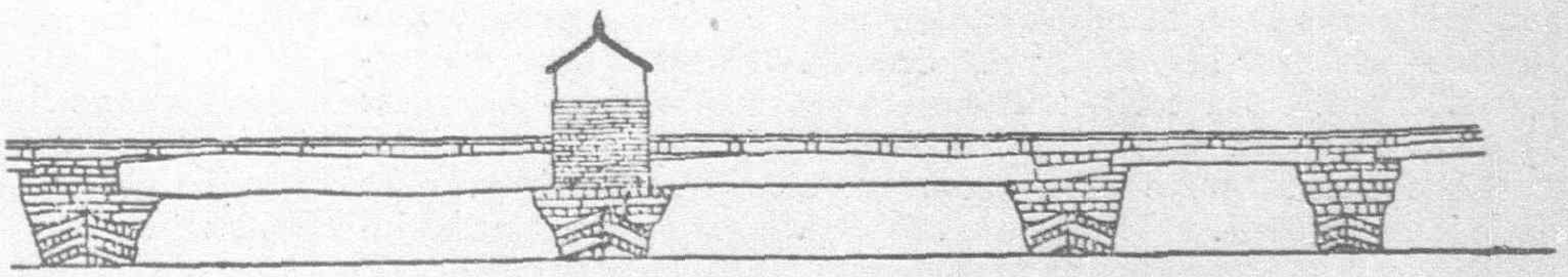


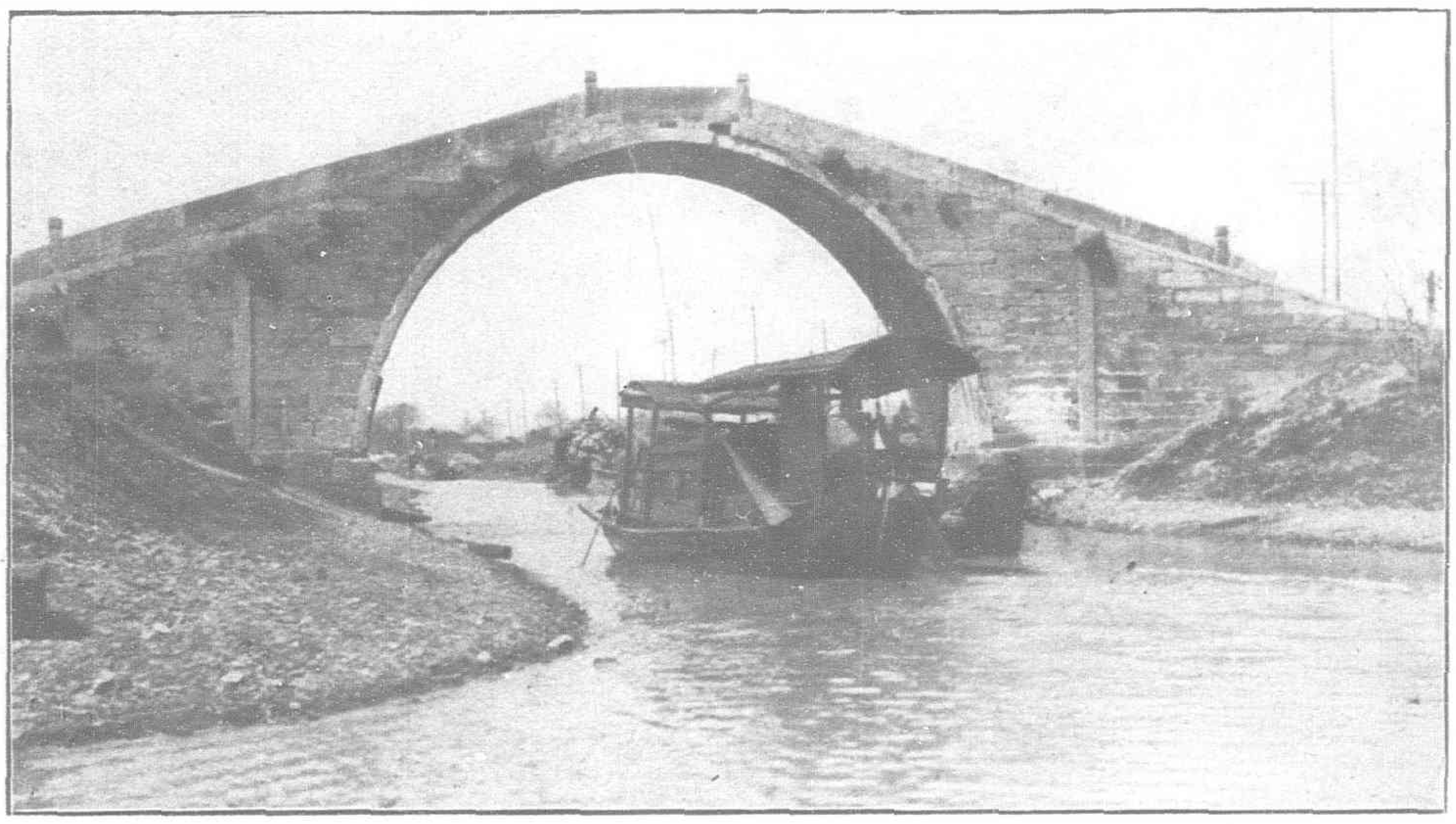
Fig. 14.—Some Spans of Poh Lam Bridge, Fukien

The fact probably is that a bridge was built during the Sui dynasty and that it has collapsed more than once, as is the case with so many other Chinese bridges, and that the bridge as it stands originates from so late a date that foreign influence has moved the mind of the builders. If it is really old it is, as far as I have been able to find out, the only one of its kind and certainly a masterpiece infinitely superior to any other bridge in China.

When a bridge is to be made and the financial side of the question is arranged, some experts are called in. The bridge or parts of it are drawn in black on the biggest white wall available and all arrangements for the space for and the shape of the principal stones are made on this large drawing.

The experts know the proper relation between the span and the thickness of the granite shell forming the arch. In bridge of unequal spans the shell is always thinner for the smaller spans. There must, however, be a difference of opinion between the experts because it is not possible to draw up a general rule from field measurements. The proportion between the thickness and the span of the arch in the bridges in the lower Yangtze Valley appear to be about 1/25 to 1/35 for the smaller spans and 1/40 to 1/60 for the biggest types.

The canal entrance through a city wall is built like an arch bridge. The load on the arch from the loose fill behind or inside the city wall is very large and the arch is therefore of heavy dimension and made of two layers of stone, build as two independent shells.



Drum Bridge in Chekiang.—Chekiang is the province of water, and accordingly the province of boats and bridges. *From the 3,600 Bridges of Husu to the 390 Bridges* of Wumen, bridges must not be overlooked in appreciating the landscapes of these southern districts. The most common type of the bridge here is the so-called "Drum Bridge." It has a large archway underneath it, allowing free passage even for sailing boats, while the roadway on it forms stairways so that no vehicles can pass over it. This fact alone explains sufficiently that the chief means of communications in this province is the waterway, and the transport on land is maintained by paranquins only.

In Western and Northern China the deck is often horizontal; in Szechuen they are in some localities built very wide and covered by a roofed building. Such a bridge is the gathering place of the whole town, where daily markets and occasional fairs and festivals are held.

Along the Grand Canal in Kiangsu some very ugly combinations of arch and slab structures can be seen spanning a few side creeks. *Fig.* 3 shows a sketch of one of them.

Combined Wooden and Stone Bridges

If one of the long stone bridges fail several times the main slab is often replaced by pine poles covered by 2½-in. to 3-in. thick stone plates. This type of construction is often found in the bridge leading over the moat up to the city gate, it is easy to disconnect and to replace during times of trouble.

The most imposing types of mixed constructions are the famous cantilever bridges in Western China, they have generally only one span. They consist of two heavy stone piers from which several layers of wooden stems are cantilevered about 25-ft. out from each side. The two cantilevers are then connected by a light bridge of five big tree trunks placed side by side. The spans are anything between 80 to 130-ft. An interesting variant of this type is found in Hunan and adjoining provinces. On top of the boat shaped massively masoned stone piers rests a superstructure consisting of a heap of round timber poles forming a sort of continuous cantilever beam system. On *Fig. 11* part of such a structure is shown. Connections between the horizontal stems are made by slender wooden pegs driven vertically through all the crossings.

Above the bridge deck there are stays for awnings. The deck is 20 to 30-ft. wide and used as a gathering place for the inhabitants of the town next to which it is built.

Several copies of this type of bridge are found in Japan.

Suspension Bridges

In the rugged mountain tracks in Szechuen near the Thibetan borders where wild unnavigable streams thunder in the deep canyons stopping the progress of the wanderer, cheaper means of getting from side to side than a bridge can afford was invented many centuries ago. Two thick plaited bamboo ropes are suspended across the abyss. The one is lifted up by shearlegs on the one side and fixed to the rock several yards below on the other. Steps then lead from the lower end of the rope up to the edge of the other side. The other rope is rigged up in the same way but in the opposite direction, both suspended in a gentle curve.

A person wishing to reach the opposite bank ties himself to a wooden ring clasped loosely round the high end of the rope or to a curved yoke placed over the rope and lets go; he rushes at a high speed down the rope, passes the lowest part of the curve, and loses his speed again on the upward part of the big stiff bamboo rope. At the end of the rope the passenger disentangles himself from his leather straps and climb up the stone steps to the edge of the cliff.

These "bridges" exist in great number and the hardy mountain dwellers and travellers use them without hesitation. In some cases there is only one rope. It is then rigged up high on both sides, and a basket which can accommodate one or two persons is permanently attached to the ring and can be pulled across by means of a lighter rope.

These primitive suspension bridges appear to be the first step towards the construction of these interesting suspension bridges, which like spider webs hang from cliff to cliff making it possible for caravans to proceed through this hostile territory.

The principle of construction is the same in all of them. A number of bamboo ropes of large dimensions are suspended parallel to each other from side to side between two heavy buildings; these ropes form the floor of the bridge. In the bridge houses each rope is fixed to a column which by means of attachable spars can be turned like a huge capstan, so as to keep the rope taut. The hand railing of the bridge consists of one or more ropes connected by vertical bamboos or by thinner ropes to the bamboos under the floor.

A floor is placed on top of the main ropes and consists of planks or of bamboo tied to the ropes. Most of these bridges only consist of a single span, sometimes as long as 250-ft. often suspended several hundred feet above the canyon it spans.

The most famous of all these suspension bridges is that at Kuang Hsien shown on *Fig. 10*. It is altogether over 700-ft. long and its maximum span has a length of 200-ft.

The bridge is 9-ft. wide and is carried by 10 bamboo ropes of 6½ inch diameter, each hand railing consist of five similar ropes. The main pier is a very heavy tower (shown in detail on the plan) the others are more flexible, and are made of hard wood. Small piles are driven into the river bed around them to prevent scouring.

The cables are fastened to huge capstans embedded in masonry, which are revolved by means of spars and which keep the cables taut. The floor of the bridge is of planking held down by bamboo rope on either side. Lateral strands of bamboo keep the various cables in place, and wooden pegs driven through poles of hard wood assist in keeping the floor of the bridge in position. Not a single nail or piece of metal is used in the whole structure.

Every year the cables supporting the floor of the bridge are replaced by new ones, they themselves replacing the rails.

I have had the opportunity to test such a Szechuenese bamboo rope here in Shanghai. It consists of a kernel of straight bamboo strips taken from the weak inner part of the stem, surrounded by several layers of bamboo fibres from the outer silica containing the strong surface of the stem. These fibres showed a tensile strength of 26,000 lb. per sq. inch.

Foreigners are often lost in surprise and admiration when they see these structures; but it is still more marvellous that a nation with such excellent material at hand has not been able to utilize it in a more sensible way. By lifting the ropes up on towers on both sides a horizontal bridge floor could at once be had, and two ropes suspended in a gentle curve could take the stress of 10 of the ropes which now by enormous effort and great ingenuity they keep as taut as possible. At the same time the required side stiffness could be given the deck, a thing which cannot be done by the present sagging structures. It is alleged that the ropes are soaked in a chemical before being placed, in order so prevent too quick deterioration. It must however be a very ineffective one if it is necessary to change the ropes every year.

The close connection between deck and lower ropes where moisture can accumulate and only slowly evaporate and the fact that sunshine never can penetrate to them explains partly their shortlivedness.

In South Western China there is a great number of iron chain suspension bridges which appear to be between 200 and 300 years old. Their spans vary between 120-ft. and a little above 300-ft. In Yunnan one of these structures have two spans, the one 150-ft. and the other 240-ft.

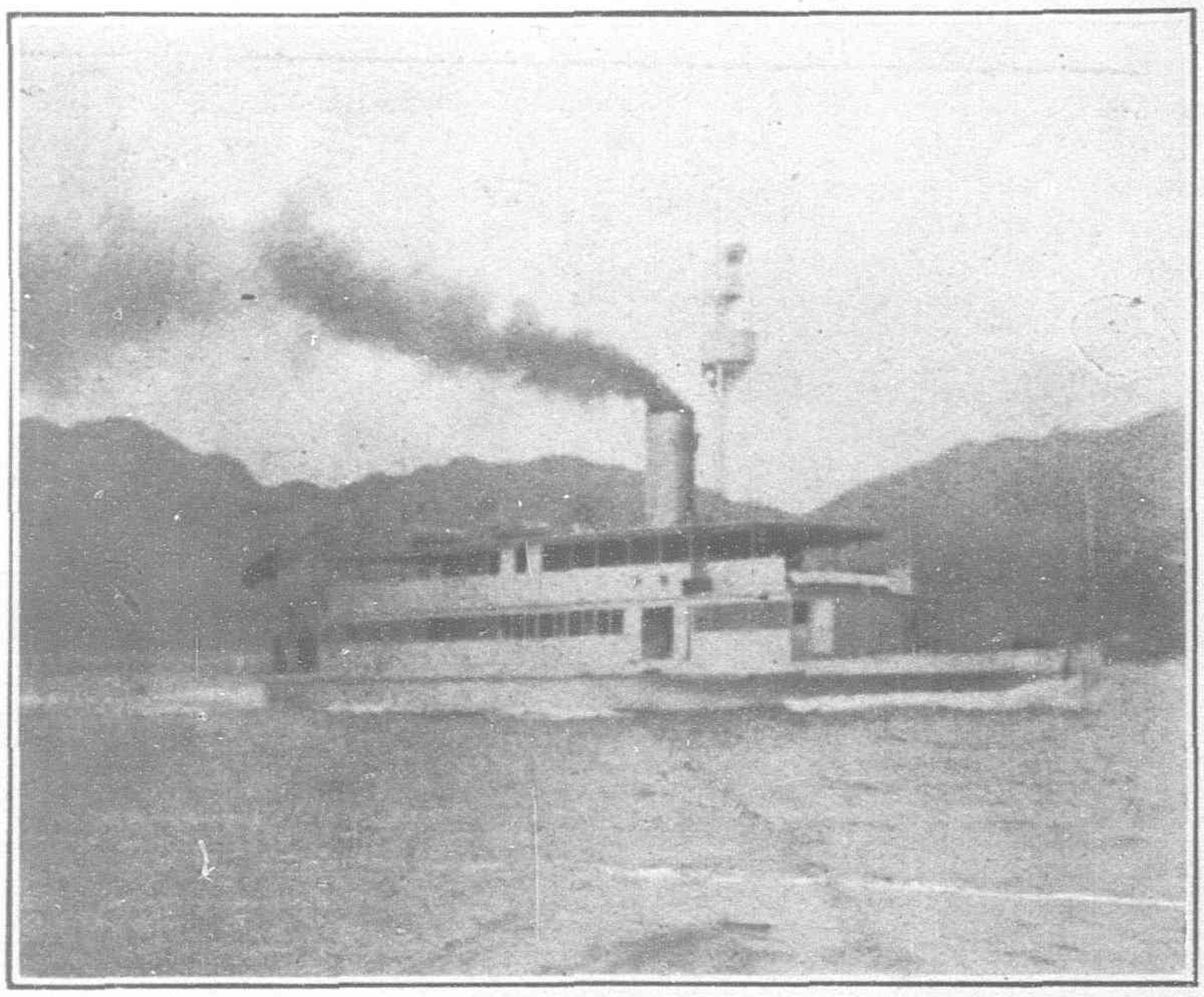
Near Ta Tsien Lu in Szechuen there is a suspension bridge called Lu Ting bridge. It is 326-ft. long 10-ft. wide and is formed by nine suspended iron chains with boards of wood for floor.

Another interesting bridge over the gorges of Hwa Kiang, Kweichow is supported by 12 chains of hand-forged iron links and has a single span of more than 200-ft.

New Gunboat for Chinese Navy

Successful Trials

THE gunboat *Kien Yu* was recently launched by Madame Li Chai Sum from the Yard of Messrs. W. S. Bailey underwent her twelve hours endurance and full speed trails in Kowloon Bay, the vessel being run at four, six, eight, ten, and twelve knots and results noted, and finally for two hours at full speed when a speed of $14\frac{3}{4}$ miles per hour against the contract speed of 14 miles was easily maintained with all auxiliary engines besides main engines at work. Tests for turning and stability and ready handling of vessel were also carried out with complete success, and during the whole period of trials with steam at 200 lbs. pressure and under forced draught, not the slightest heating or hitch of any kind occurred.



The "Kien Yu"

The new vessel is a steel twin screw river gunboat, her dimensions being length 121-ft, breadth 21-ft 6-in., depth 8-ft. Service speed is 14 miles per hour on maximum draft of vessel of 4 feet 6-ins. The vessel is built of galvanized steel with straight stem and cruiser stern. The steel deck houses occupy the middle of ship with clear deck space forward and aft, there is a steel mast of lattice type for carrying a machine gun, search light and wireless antennae in conjunction with a short wooden after-mast and rigging serving for general outlook. Bullet proof plating and wire netting are fitted along both sides of the ship in way of main and upper decks. The crew is housed under deck and the Captain and officers on the upper deck which is built over a steel house and extends to the ship's sides. The whole length of the vessel is divided into nine water-tight compartments by steel bulkheads.

For quickness in turning there are two rudders of spade type. Bullet proof plating is also fitted in way of engines and boilers and around the four sides of the upper deck. The ship's sides are armored from under side of fender to six inches below the waterline in way of magazine and machinery spaces; bullet proof shields made to raise or lower are fitted at decks.

The primary gun is housed forward on the upper deck on a strong steel support. Smaller foundations are fitted for lighter guns. The vessel's wireless has a day and night sending and receiving radius of 500 miles.

Electric signal lights are fitted at mastheads, protected by metal frames and connected to the Morse keyboard. The wheel house is fitted with metal racks for rifles, engine telegraph and voice tube, etc. and the windows are fitted with bullet proof shutters. An ammunition hoist located in the crew space forward with an iron ladder to deck, is fitted with hoisting gears and buckets and bullet proof steel cover. There are three crew spaces, one forward and one aft of magazine, and one abaft engine room. Metal lockers are provided for effects of the crew. The Captain's room is on the upper deck and has a white enamel bed with spring mattress, locker, lavatory, and upholstered settee and bell pushes, etc. Baths are provided for Captain and officers.

The engines are triple compound with condenser athwartships and common to both engines, and all pumps are independent of main engines. All workmanship and materials are in excess of Board of Trade requirements. The condenser is of the Uniflux type with solid drawn brass tube. The air pump is of the Mono type, independent and steam driven, while the circulating pump is also independent.

There are two general service pumps with connections to every part of the vessel.

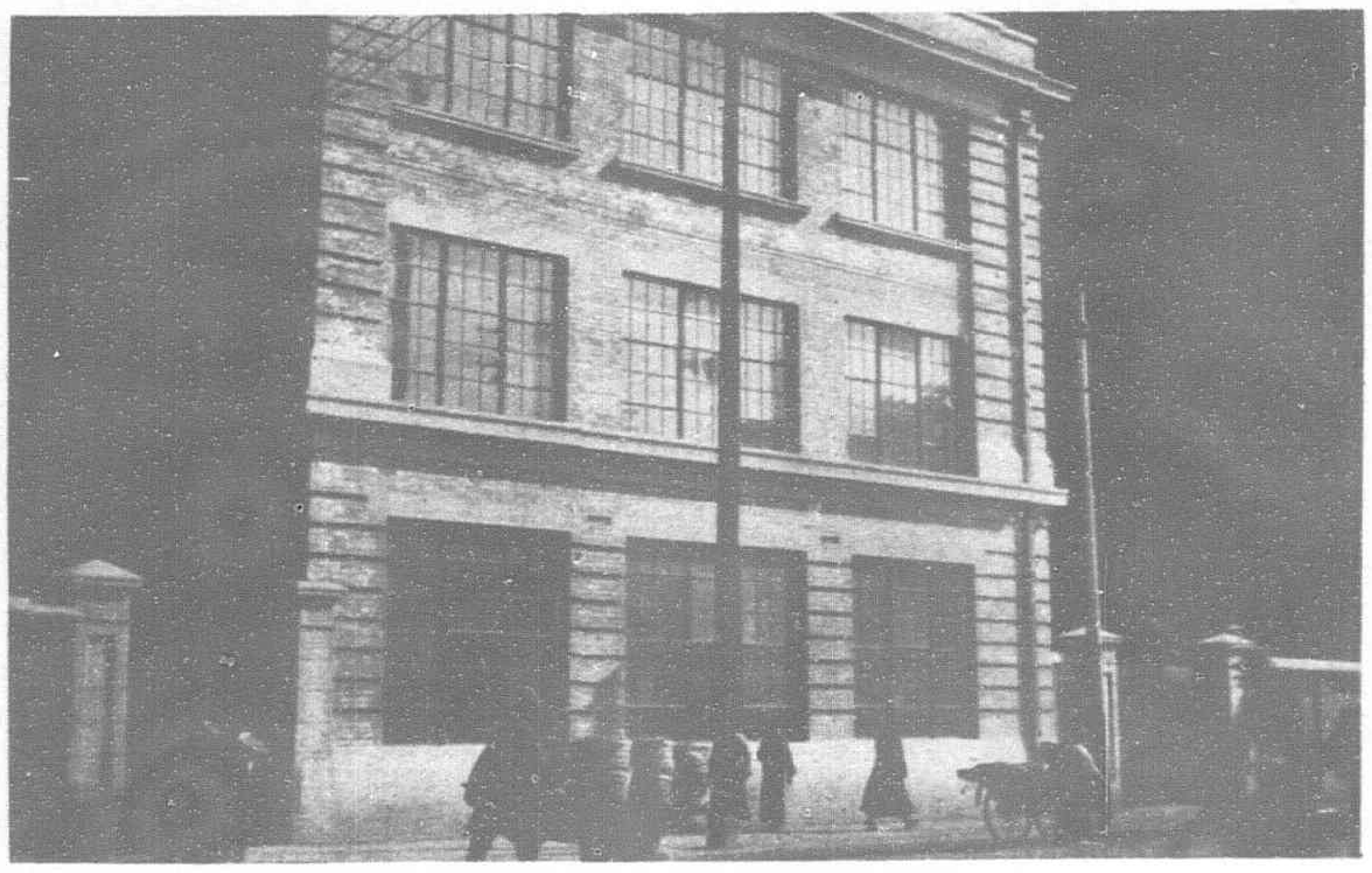
Steam is supplied by a water tube boiler of Thornycrofts latest type, tested to 350 lbs. and working at 200 lbs. per square inch, and is of 2,300 square feet of tube surface. The boiler casings are of steel, lined with asbestos. All engine and boiler fittings and mountings are of the very highest class.

An eight kilowatt electric steam generator set, oil driven generating plant, switch board and also a fire pumping set are fitted.

Shanghai Gas Works

RECENT articles in the " Gas Journal " of London, written by Mr. Walter Buchler, invites attention to the growing demand for gas in China and Japan and markets for gas appliances, which, in spite of electrical competition, are being more and more employed both by Chinese and Japanese as well as foreign residents. In China, at present, the major demand is in Shanghai and Hongkong ; but with the growing industrialization of the country, the demand is bound to spread to other important centers. Some interesting statistics are given by Mr. Buchler showing the imports into China of gas fittings, stoves, and grates, during recent years.

There are only three important gas-works operating on any large scale in China. Of these, the Shanghai Gas Company is the largest. The other two are the Hongkong Gas Works (Hongkong and China Gas Company, Ltd.) and the Dairen Gas Works operated by the South Manchuria Railway. Shanghai is the largest user of gas for all kinds of purposes. In spite of intensive competition from an efficient municipal electricity concern which supplies the whole town with light and power, the public, both Chinese and foreign residents, are using more gas ; the demand growing from year to year. The present three gas works in China have to cope with an overgrowing demand for gas for industrial purposes. China has ample supplies of cheap coal, suitable for making gas, and there is a steady demand for coke, tar, desiccated tar, tar distillate, pitch, and sulphate of ammonia, considerable quantities of which are also imported.



West End of "New Workshops," Thibet Road

Exporters and manufacturers of gas stoves, grates, appliances, and fittings will find good scope for selling their specialities in the Chinese market. There is already a considerable demand, and imports are by no means negligible, as the following statistics show.

There is also a growing demand for all kinds of cooking utensils, as well as for enamelled ironware and hardware, imports of which into China during 1927 were valued at £19,000 and £143,000 respectively.

Imports into China of Gas Fittings, Stoves, and Grates.

GAS FITTINGS

from	1924. £	1925. £	1926. £	1927. £
Great Britain	7,500	10,800	17,000	—
Germany	21,500	22,600	44,000	—
U. S. A.	10,000	9,100	4,980	—
Total including others	46,300	57,600	78,160	40,000

STOVES AND GRATES

from	1924. £	1925. £	1926. £	1927. £
Great Britain	21,000	12,800	9,600	—
Germany	40,000	23,000	54,900	—
U. S. A.	12,300	13,300	13,200	—
Total including others	95,000	68,400	111,000	79,000

Coal Gas Manufacture and Progress of the Shanghai Gas Co., Ltd.

The Works of The Shanghai Gas Co., Ltd. were originally contained on a small piece of land, about 4 mow in area, at the junction of Soochow Creek and Thibet Road.

The erection of the Works was begun in 1864 and the following table shows the progress of the Company up to December 31, 1928.

Year	Site area Mow	Gas sold cubic ft.	Number of Consumers	Price of Gas	Length of gas main miles
1866	4	5,318,000	58	$4.50	4.8
1928	42	567,581,000	10,035	$2.45	160.0

The majority of the coal used is Japanese and the Coal Storage Capacity is 6.000 tons.

The coal carbonized per year is about 40,000 tons.

To produce coal gas, coal is distructively distilled in Fireclay Chambers called Retorts which are arranged in groups of eight called a Setting ; each Setting has a furnace nestled beneath the Retorts.

Coke is supplied to the furnaces and the Retorts are heated on the two stage combustion principal.

The Company now have 23 such Settings or 184 Retorts or Chambers each Retort being 22-ft. long by 22-in by 16-in. in area ▭ shaped, and are filled with 8 cwts. of coal every 8 hours.

A setting of eight Retorts has a life of about 900 days and usually works continuously day and night at a temperature of 2,000° F. from the day it is first charged with coal to the day it is shut off for demolition and reconstruction.

The products from the distructive distillation of coal are, Crude Coal Gas, Coke, Tar and Ammoniacal Liquor. The Tar and Liquor are run off to large storage wells, the total capacity of which is 446,000 galls.

The Crude Coal Gas, leaving the retorts at a temperature of about 250° F. contains impurities, the chief being Light Tar Vapours, Ammonia compounds, sulphur chiefly as sulphuretted hydrogen, carbon dioxide and cyanides. The first operation in the cycle of the purification of coal gas is to reduce the temperature of the gas to normal atmospheric temperature by passing it through air cooled condensers.

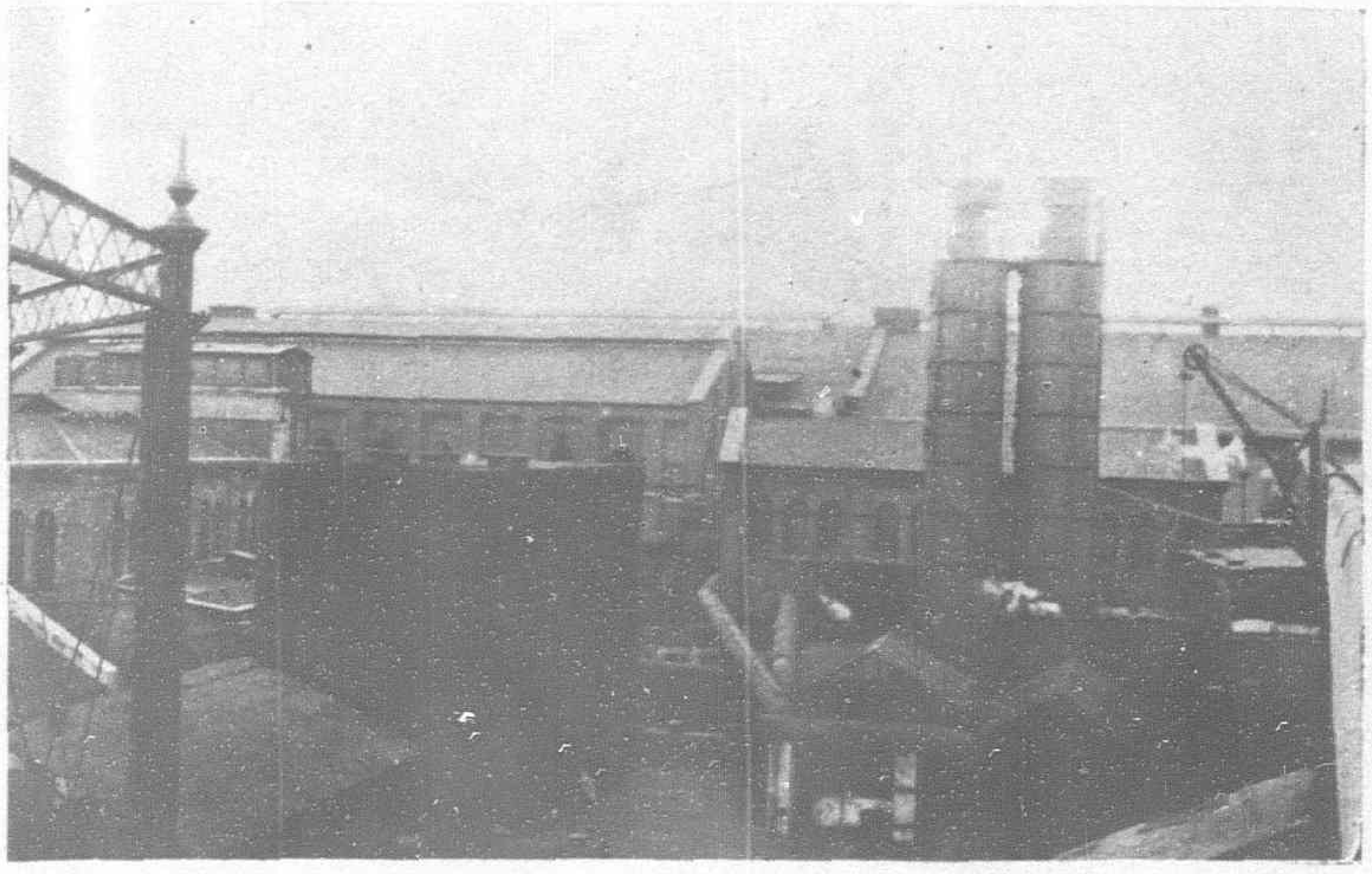
In tropical and semi-tropical climates, air cooled condensers are found to function better than water cooled condensers, chiefly because the temperature of the water is too high during the hot weather, and an immense supply of such water would be necessary requiring very large units of expensive condensing plant.

During the cooling operations, a great quantity of Tar Vapour and Ammonia Vapour, etc. is condensed out and run off to the storage wells.

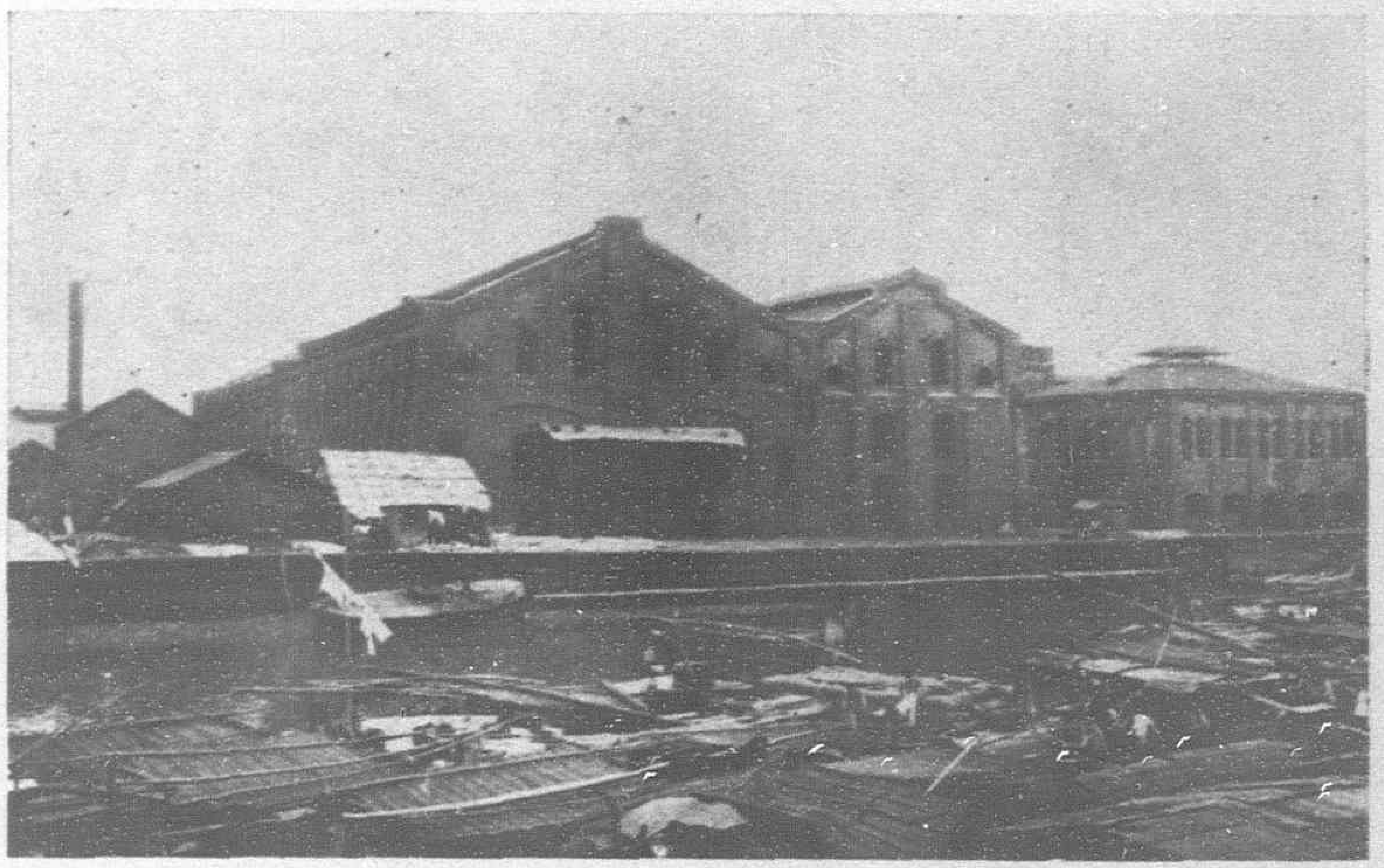
The second operation is to remove all Ammonia, this is carried out in various types of apparatus, but the principal of them all is the same, *i.e.* to expose a large, rough wet surface to the passage of the gas. The rough surface is kept wet by a continual supply of weak Ammoniacal liquor and finally by cold water.

The resulting liquid is a fairly strong ammoniacal liquor, about 10 oz. strength, this is run off into storage wells to be ultimately made into sulphate of ammonia.

During the washing and scrubbing process a certain amount of Carbon Dioxide and Sulphuretted Hydrogen is removed from the gas, but the content is still very high ; and in order to conform to the Gas Regulation Act which forbids even a slight trace of Sulphuretted Hydrogen in the final gas supplied to the Consumer, the next operation is to remove this impurity.



Purification Center with Retort Houses in Background



View of Bund, Showing Retort Houses

This is carried out in large Cast Iron Boxes filled with a mixture containing a high percentage of Ferric Oxide. The mixture is prepared on the Works from Iron Borings. The Boxes for this operation are four in number each 50-ft. by 32-ft. by 6-ft. deep and each containing 120 tons of "The Mixture."

The action of the gas on this oxide is a chemical one and the final oxide after it has absorbed so much sulphur that it is useless as a purifying medium contains about 50 per cent. free sulphur.

This material in most parts of the world is valuable, the free sulphur is extracted for various uses, but The Shanghai Gas Co. have to pay for its removal from their Works. About 400 tons containing 50 per cent. Sulphur is disposed of per year.

The gas on leaving the Sulphur Purifiers is fit for use in consumers appliances: it is measured in a large gas meter and passed into gas holders and thence to the district.

The final gas has an analysis of :—

Carbon Dioxide	4 Per cent
Oxygen	2 ,, ,,
Hydro-Carbons	3 ,, ,,
Carbon Manoxide	8 ,, ,,
Methane	20 ,, ,,
Hydrogen	30 ,, ,,
Nitrogen	33 ,, ,,

and calorific value of 440 B. Th. Us per cubic foot. The processes of working up the residual products, Ammoniacal Liquor and Tar, into saleable commodities are purely chemical operations. Ammoniacal Liquor is boiled with sulphuric acid to form Ammonium Sulphate, a grey crystalline material, which is an excellent fertilizer containing about 20 per cent. nitrogen. Some 150 tons of sulphate of ammonia are manufactured per year.

The useful commodities obtained from Coal Tar are almost innumerable, but the chief can be classified as disinfectants, dyes high explosives and the bases of many toilet perfumes. The Shanghai Gas Co. merely distill a great portion of their Tar to Pitch which is sold for Briquette making purposes, and sell the resulting Creosote Oils, etc. in bulk to Chinese Contractors. Quite a large quantity of Crude Tar is dehydrated for Road making purposes and the remaining Crude Tar is sold to the Chinese for various uses.

During a year some 550,000 galls, of crude coal tar are worked up into useable commodities.

At the present time the market for Tar, Pitch and Tar products is so poor that Tar is being used as a Boiler fuel; this is extremely successful.

The pure coal gas is distributed from the Works to the consumer at an initial pressure of 4½ inches W. G. through :

Three 14-in.	diameter	C. I. Pipes
One 12-in.	do.	C. I. Pipe
One 18-in.	do.	C. I. Pipe

The supply to the outskirts of the district is boosted up by gas at high pressure supplied from gas compressors working at an initial pressure of 14 lbs. per sq. inch. and governed down to a final pressure of 3 inches W. G. The gas load is chiefly for cooking and water heating and varies from 1,400,000 c. ft. per day in Summer to 2,300,000 c. ft. per day in Winter.

All gas consuming apparatus, meters, cooking stoves, geysers, etc. are repaired in the Company's own Workshops by a large staff of Chinese Mechanics under foreign supervision.

During one year this department repairs and passes out :

6,140	Gas Meters
4,290	Gas Cooking Stoves
1,650	Water Heating Appliances

The Chinese are rapidly becoming favorably impressed by gas for household use, and the department, manufacturing a special type of Chinese Cooking Stove, has grown tremendously during the past year; 130 of these stoves were fixed in Shanghai during 1928, bringing the total number fixed on the District up to more than 800.

The Shanghai Foreign Public have shown great appreciation of the New World Gas Cooking Stoves which were introduced to them early last year, and more than 500 of these stoves have been installed during 1928.

The Japanese and Russian population favor the small Hotplates and Grillers which are very economical but only suitable for cooking small quantities of food.

The "Humphrey Gas Geyser" is more generally popular than ever amongst the foreign and Chinese populations and most Architects arrange for them in Bathrooms, unless the house has an outside furnace, etc. supplying hot water. "Automatic Gas Water Heaters" fixed to supply hot water for all usual purposes are very popular in large private houses especially in the Summer.

A steady increase in the gas sold during the past few years, about 6 per cent. per annum, has entailed the building of a Reinforced Concrete Storage Tank for Tar and Ammonaical Liquor having a capacity of 160,000 gals.

In 1927 an artesian well was sunk to a depth of 300 ft. To supply all the water used on the Works and Plant.

The growth of the gas cooking and water heating business has made it essential for the Company to have larger and modern repair and assembling workshops and a 3-storied building 60 ft. by 150 ft. has just been erected to cope with this work. The building is arranged with central heating, electric lift, and other modern requisites; new high speed drills, planing and shaping M/Cs, and a 22" Lathe have been installed to cope with repairs to the ever increasing Works Mechanical Plant.

Owing to the great increases in gas consumption during recent year, the Company's carbonizing plant is now working at almost its full capacity to cope with the winter load, and extensive installations of modern Carbonizing Plant are anticipated in the near future.

FIGURES SHOWING RECENT INCREASES IN GAS MADE AND GAS APPLIANCES FIXED IN SHANGHAI.

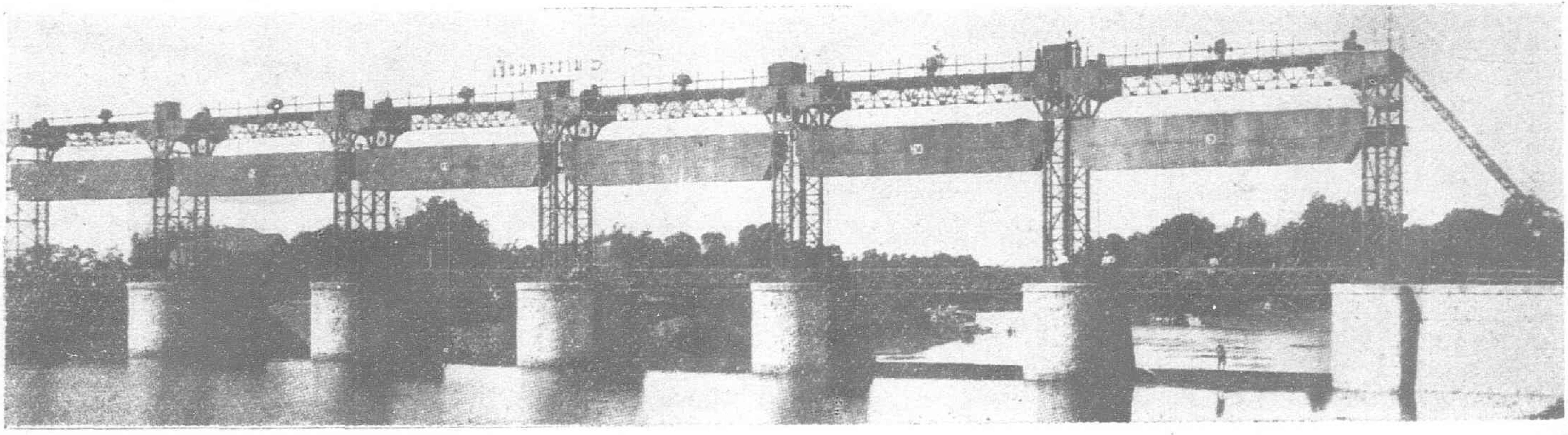
Year	Gas made cu. ft.	Foreign Cookers	Chinese Cookers	Grillers and Hotplates	Water Heating Appliances	Consumers
1925	536,849,000	3537	559	2211	1442	8822
1926	568,083,000	3905	604	2431	1349	9302
1927	596,890,000	4228	684	2583	1426	9600
1928	623,024,600	4622	814	2740	1529	10035

Irrigation in Siam

Completion of the Prasak South Canal

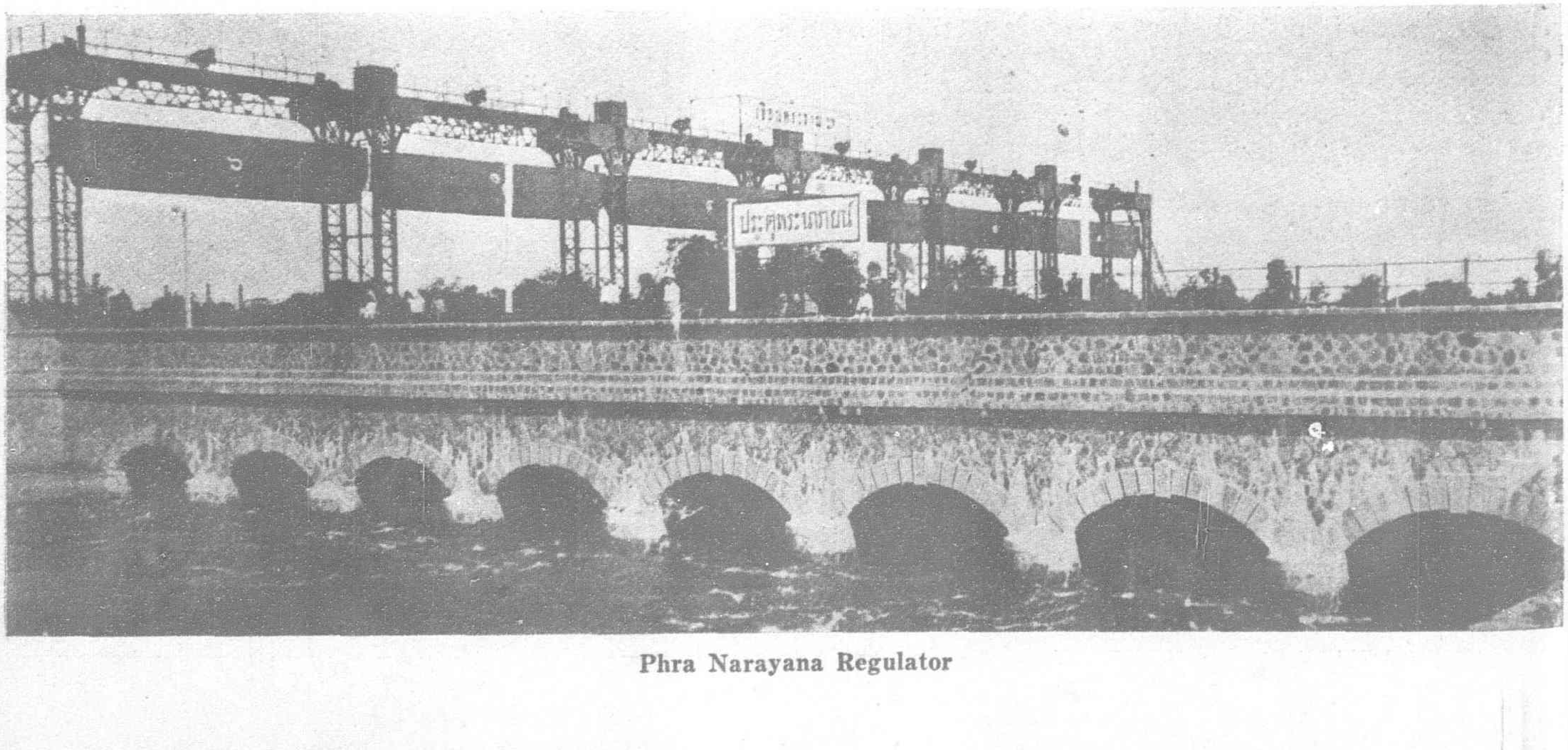
It was towards the end of the year 1915 that His Majesty's Government decided that the Prasak South Canal project should be proceeded with first, accordingly arrangements were made to close down at once the work which had been started on the Subhan project in anticipation of this being the selected project which would inaugurate the introduction of scientific irrigation into Siam, as recommended by Sir Thomas Ward.

A brief note is necessary here as to the reasons which led to the selection of Dha Luang as the site for the construction of the head-works of this irrigation system. In Sir Thomas Ward's original proposals, the site selected was in changwad Saraburi, and the reason for this selection was probably, that here, there appeared to be a good rocky bed in the river, which seemed eminently suitable on which to found so important a structure as the barrage. More detailed investigations proved however, that the rocks at Saraburi are isolated patches of stone, and are not continuous over the river bed ; at the site proposed the rock could be located about half way across the river only, and from thence could not be located at a reasonable depth. This meant that the foundations would have been partly on rock and partly on softer material, a condition which would have been most unsuitable.



Rama VI. Barrage

A further important consideration in the selection of the final site for the headworks was, that if built at Saraburi the offtake of the main canal would have been at too high a level to have admitted of it being linked up with the proposed barrage across the Menam Chao Bhraya, and the Prasak South Canal instead of forming an important link in the scheme of canals served by this main barrage would have remained isolated and cut off from the main source of supply. Now however should the main barrage at Jainadh ever be constructed, it will be possible to link up the Prasak South Canal with it and to feed it with water from the Menam Chao Bhraya, and the supplies of the Menam Prasak, which in this event would no longer be required for the Prasak canal, could by the construction of another barrage above Saraburi (Geng Koi) be utilized for the irrigation of the large tracts of land lying on both banks of the Menam Prasak. These considerations led to the selection of the present site. A further advantage of the Dha Luang site is that the works have been constructed in the chord of the large hair-pin bend which exists here, and which enabled the works to proceed steadily throughout without interference from the river floods. On completion of the works the old channel of the river was closed by means of a dam which is situated just to the north of the lock channel, and a new channel for the river was excavated passing straight over the barrage. The effect of this straightening out of the river, apart from the facilities afforded for construction, has been to lower the general level of the river water level in flood by about 35 centimeters ; that is, should a similar flood occur as in 1917 the water level with the facilities now provided will be 35 centimeters less than the level reached in 1917 and the depth of



Phra Narayana Regulator

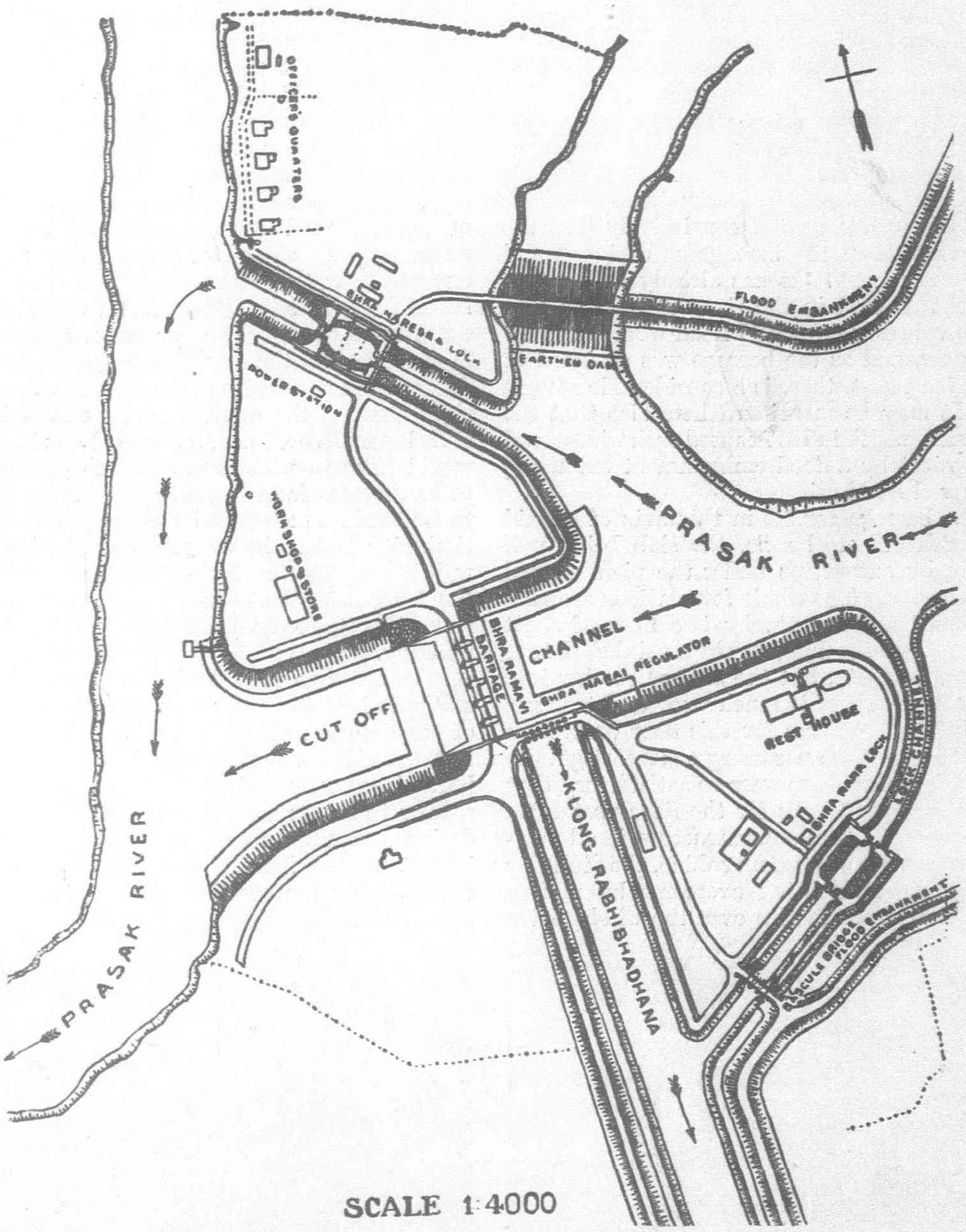
spill over the banks which was so disastrous then will be reduced by this amount. In time of high flood this reduction in level will be of incalculable benefit to the country.

Materials

For the successful and economical construction of works of the magnitude of the Prasak works much depends on obtaining suitable materials, and whether the same are so situated as to render their use a business proposition. The main difficulty was in obtaining suitable stone. Siam is rich in limestones, but unfortunately this stone is generally too soft and is too susceptible to water action to be at all suitable for a barrage, which has to pass water acting under the influence of a head of pressure of 7½ meters. In changwad Saraburi, however, there exists a range of low hills composed of a very hard compact lime stone, and this stone shows no signs of disintegration from the action of water so common in limestone formations generally. Laboratory tests showed the stone to have a very high crushing strength, and to have a specific gravity higher than ordinary limestones and approaching that of good granite. The only drawback to the stone is that, under the influence of subterranean heat or pressure, or actual earth movement, the stone has become distinctly micro-crystalline in form, and in consequence it is difficult and expensive to work up into building blocks. On the whole, however, whatever geological changes it may have undergone the stone is suitable for hydraulic works of the character of the headworks of the Prasak canals. It was decided therefore to use this stone, and the department were fortunate in being able to secure from the Siam Stone Works, their old quarry at Saraburi on very reasonable terms. The quarry at Saraburi has the additional great advantage in that it is easily accessible both from the Northern Railway and from the Prasak river.

Cement for the works has been supplied throughout by the Siam Cement Company, suitable sand was found in the Prasak river in abundance and the resulting mortar passed all tests satisfactorily. The cost of other building materials increased enormously during the period under construction; the cost of cement alone rose one hundred per cent. Owing to the very high cost of labour in Siam even when the works were first contemplated, it was at once evident that if the works were to be carried out at anything approaching a reasonable cost, machinery would have to be adopted extensively. After due consideration it was decided to adopt dragline excavators, which type had given excellent results in the United States of America. Accordingly an order was placed with the Bucyrus Co., of Milwaukee, U.S.A. and the Marion Co., of Marion, U.S.A., for one each of their larger type of machines, Model 175 and Model 251 respectively. These machines are capable of digging 4½ cubic meters of earth at one cut, and depositing the same directly on to the spoil bank and have a swinging radius of 28 meters. The parts of these machines began to arrive in Bangkok in August 1916 and by November they had been completely erected and were ready to start work. The introduction of these machines marked a distinct advance in irrigation work in the East. They worked steadily on the excavation of the canal and branches throughout the whole period of construction, and proved so successful that two more machines but of smaller type, were purchased and put to work in the canal, one in December 1918 and the other in August 1919.

Other important plant secured for these works comprised a suction dredger, which was used in cutting the straight channel for passing the river supply over the barrage, and a large steam shovel which was used exclusively in digging the pit in which the barrage and head regulator were constructed. This shovel originally belonged to a tin mining company at Lang Suan, and on this company being liquidated, it became the property of government. After lying some 10 years in the jungle it was made over to the Royal Irrigation Department on condition that the department would arrange to transport it from the jungle where it was lying. As the original railway line leading to the tin mine had been dismantled, and all the bridges had fallen into disuse the transport of this shovel was a matter of considerable difficulty and expense. The shovel, however, was in very good condition, and when brought and erected at Dha Luang, its cost to the department was about 1/3 of what it would have cost to purchase a new one.



Prasak South Canal.—Site Plan of Head Works at Dhaluang

The headworks of the canal system in addition to the excavation of the new river channel, and the construction of the dam closing off the old channel, consist of a barrage, a head regulator, a lock to pass boats between the higher level of the river upstream of the barrage and the lower level downstream, a lock leading from the river into the new canal, and bridges for traffic across the new channels.

The Barrage

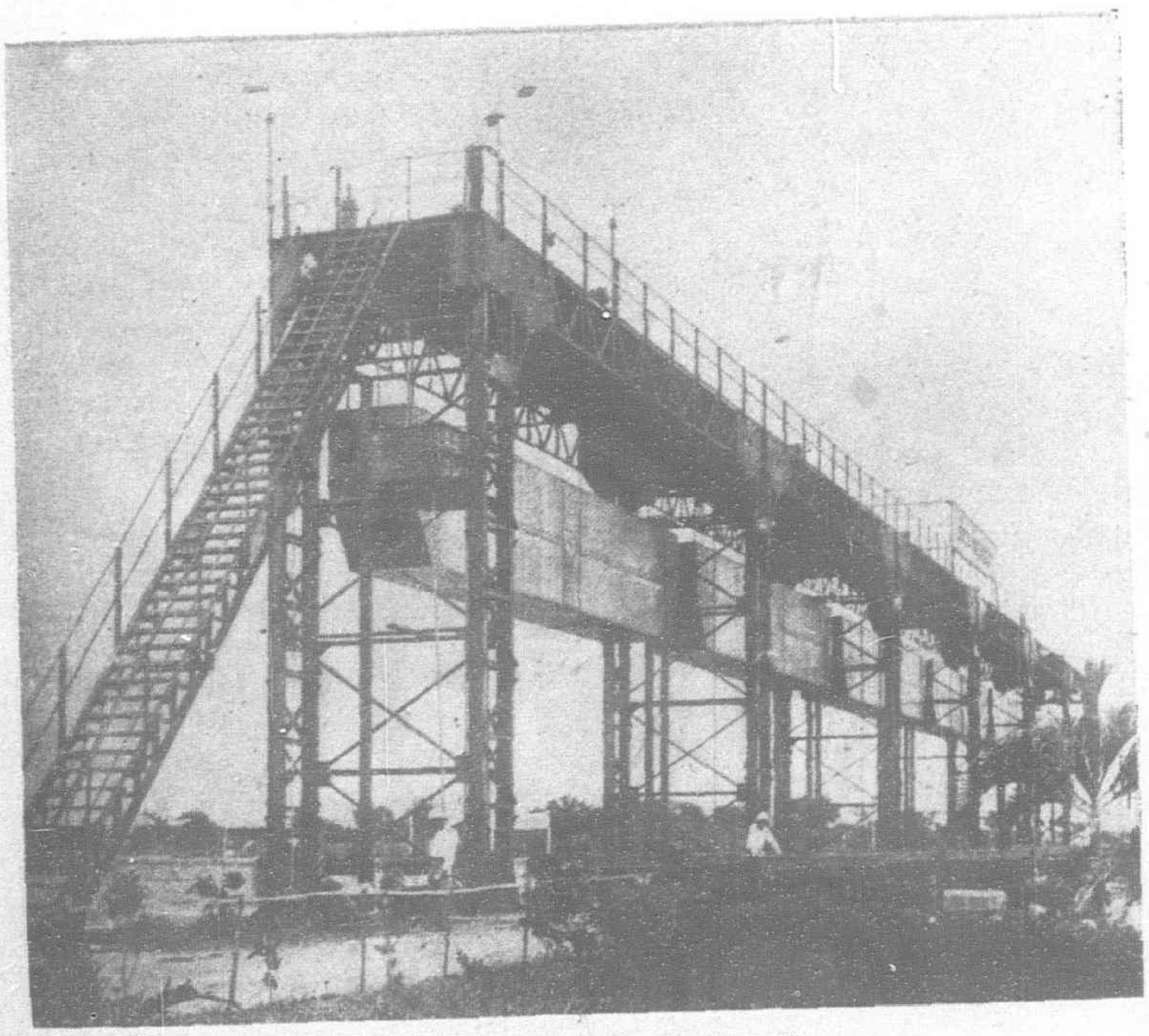
This consists of six spans 12.5 meters clear, and has a height of 12.1 meters, from the floor to the top of the masonry piers and abutments; built up from these are steel towers supporting a regulating platform for working the gates, and carrying the lifting machinery and counterbalance boxes; in all the deck of the regulating platform is 22.77 meters above the floor of the barrage. The sluice gates themselves are 13.1 metres in length, 7½ meters in height, and they are designed to hold up a head of water to the full height of the gates. The gates work on a system of free rollers known as the "Stoney" system, and can be operated by two men; they are fully balanced by steel counterbalance boxes filled with stone ballast and the total weight of each gate is 41 tons, and that of the counterbalance 82 tons.

It may be noted, that in the original estimate for the barrage four spans only were provided, instead of the six as finally constructed. The reason for the extra two spans was that fuller investigation than the engineers who drew up the original project had the time to make, enabled a fairly accurate forecast of the maximum flood height and discharge of the river to be made and this forecast formed the base of the calculations for the barrage as now constructed. The high flood of the year 1917 gave the engineers an opportunity to compare their forecast with the flood height and discharge of that year, the result of the comparison indicated that the flood of 1917 was not the maximum which may occur, as it was 15 centimeters lower than the predicted maximum, and it also proved conclusively that the increase in the number of spans of the barrage as designed and carried out was absolutely necessary. It has already been noted that, with the improvement effected in the river channel at Dha Luang, a flood of the same volume as the 1917 flood would not now reach the height of that year, and as the barrage was designed to pass an even greater flood than that, there is a considerable margin of safety in the design. It may be mentioned here also that the river spill on the southern side, which in 1917 caused such widespread disaster, is now insured against by a flood embankment extending from Dha Luang to changwad Saraburi.

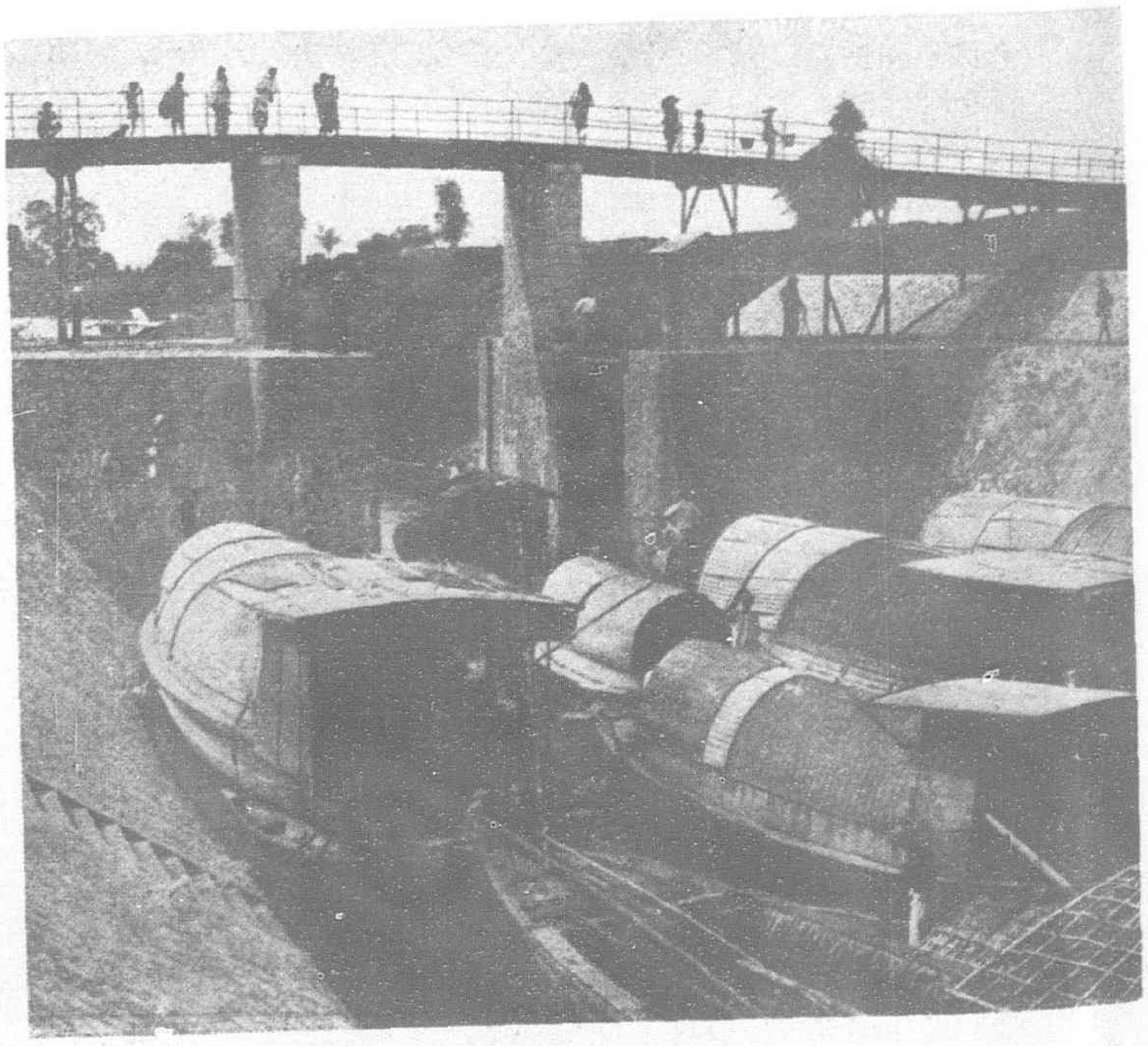
The foundations of the barrage consist in the main of a solid concrete slab reinforced with old steel rails, the slab being well pinned down into the clay by extensions under the piers carried down five meters below the floor. The whole foundations are protected against "blowing out" underneath, by two lines of sheet piles carried to seven meters below the floor, and by a third shallower line. All foundations are of concrete, but the surface coming into contact with the water on which there is much wear and tear has been protected by stone blocks. At first for this floor protection it was thought that it would have been necessary to import granite blocks, but the tests of the Saraburi stone were so satisfactory that it was decided to quarry and dress blocks for the floor protection in the department's own quarry. The superstructure is all composed of masonry of the type known as random rubble, the difficulty of obtaining sufficient through bond being overcome by placing horizontally, a good reinforced concrete slab over the whole of the piers and abutments at every two meters interval in height; all the piers have carefully designed cutwaters upstream and they are semi-circular in plan on the downstream side. Great delay occurred in obtaining the steel gates, steel superstructure and operating machinery. Arrangements had been made with Messrs. Glenfield and Kennedy, Kilmarnock, Scotland, to supply these. The department was able to commence the erection of the steel work in May, 1921, and the work was successfully accomplished by September, 1921. This was fairly rapid work; it was facilitated, however, by the care that the makers had taken in fitting the different parts during manufacture and the few minor defects were easily put right by the erection staff. The total cost of the gates, superstructure and machinery landed in Bangkok was Ticals 509,250.

Owing to the plan adopted for building the barrage in the dry and turning the river over it, little engineering difficulty was experienced in carrying out the work, the most difficult work being the excavation of the barrage pit owing to the makeshift character of the plant which had to be used. With the exception of this, however, only one case of real difficulty was met with and that was in the construction of the left abutment and retaining walls. Here when the foundations were being dug a band or fault of poor yellow clay, mixed with many impurities, between an upper layer of moderately good clay and a lower layer of good stiff red clay was uncovered; this band of impure clay rapidly disintegrated when exposed to water action, all soil cohesion was destroyed and heavy landslides occurred. These slides necessitated the removal of much extra earth to relieve the pressure, and as the band of yellow clay dipped sharply, the foundations here had to be carried down much deeper than the designed level, as it was absolutely essential to cut right through the unsatisfactory material and found well into the stiff clay underneath. As it was also evident that the retaining walls would have to withstand an earth pressure greater than appeared to be the case from the nature of the general upper strata, they had to be made much heavier than originally contemplated. Heavy timbering had to be resorted to in laying the foundation for these walls, but once the foundations were in place, and were raised to the level of the floor of the barrage, all movement ceased, and from this time onwards the work became a matter of simple building.

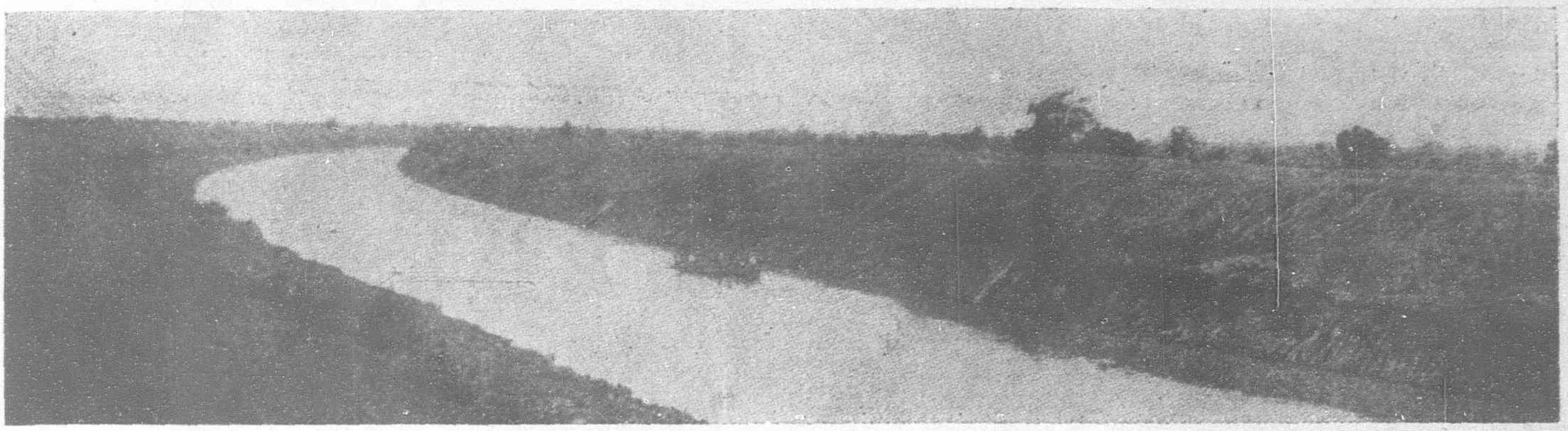
In order to provide for the convenience of the villagers who cultivate land in the vicinity of the works, a road bridge consisting of steel warren girders carrying a hardwood timber roadway has been provided and the undersides of the girders of this bridge have been placed one meter above the highest probable flood level. With a view to future road development in Siam, this bridge had been designed strong enough to carry heavy motor traffic, and it has in fact been well tested by having supported a heavy locomotive crane during the erection of the steelwork of the gates and steel superstructure.



Superstructure of Rama VI. Barrage



Phra Nares Lock



Completed Reach of Main Canal Rabibadhana

Before closing a description of the barrage, the protection provided against scouring action of the water passing through the barrage under a high head of pressure, and with a high velocity requires mention. From the downstream end of the piers there is a solid concrete floor faced with Saraburi stone, this solid floor is 10½ meters in width, and beyond this, flexible protection has been provided in the shape of concrete blocks, each block being exactly one cubic meter in volume and weighing 2¼ tons. These blocks are not closely packed but have definitely calculated spaces between, so that any block can easily conform to any scouring of the river bed, and the danger of caves being formed under the floor which might not make themselves evident until a large portion of the floor suddenly collapsed is eliminated. The side slopes are protected by solid revetments of rubble masonry built in the form of a section of a hollow cone lying on its side, and these cone shaped revetments in conjunction with the sloping extension of the abutments form the downstream water wings of the barrage. This form has been adopted as it has been found that such wings reduce the tendency of the water passing with a high volocity through such a structure, to form eddies and cross currents with the consequent wear and tear on the structure, and a smoother flow is obtained than where the wings have abrupt terminals. Beyond the terminals the slopes are rubble pitched, *i.e.* stone laid in the form of rubble masonry but without mortar, and beyond the pitching. rip-rap protection has been provided which is simply angular stone thrown on the slopes and allowed to take its own form. At the foot of the slopes there are rip-rap aprons extending into the stream, the amount of stone placed in these aprons being sufficient to pave any scour hole that may occur in the bed.

In general design and construction the head regulator is the same as the barrage of which it forms a part. It consists of 8 spans of 4.2 meters each and each span is closed by a steel gate, which, like the gates of the barrage, are designed on the " Stoney" principle and are counter-balanced. The gates were built locally in the Royal Irrigation Department's Workshop, and the counterbalances of reinforced concrete were built in situ, but the gearings, roller fittings, and grooves were obtained from the same makers in Scotland who built the barrage gates. Over the regulator also, a roadway carried on brick arches has been provided against any heavy traffic in the future.

River Lock

This lock, in essential features of design, is the same as already described for the other works ; some special points regarding it may be emphasized however, and one of these is that it is designed to lift boats between two levels the difference of which may be as much as 7½ meters ; this difference is about the limit advisable for any single lock, a greater lift being generally provided for by a series of locks. The upstream gates are built on a cill 3 meters above the lock floor, and are 6 meters in height, and the lower gates built on a cill which is level with the lock floor are thus 9 meters in height. These gates which are the largest lockgates in Siam, were built with all sluices and operating machinery in the Central Workshop of the Royal Irrigation Department, and the gearings for operating the shutters for filling and emptying the lock, are specially constructed with ball bearings with a view to reducing friction to a minimum. Another special feature of the design of this lock is, that in the event of the occurrence of a big flood the gates can be opened, and water allowed to flow through and over the lock without damage, thus providing additional waterway to that provided by the barrage itself. A trestle road bridge strong enough for heavy traffic has been built over this lock, the trestles being made up locally of steel rails.

The canal lock, which has been constructed for the purpose of taking boats from the river into the canal, is of the standard type usually built in Siam, and the general design is in keeping with the other works. One special feature of this lock however which is worthy of note, is that it was the first lock to be fitted with improved cast iron sluice valves for filling and emptying the lock chamber. These sluices were specially designed by one of the engineers of the department, and the principle of the design is such, that they are perfectly balanced and their operation can be carried out just as easily at the maximum water pressure as with no water pressure at all. These sluices, it may be mentioned, are being provided at all locks wherever possible and being made of cast iron, are particularly suitable for locks situated in areas affected by salt water. In connection with this lock a bridge over the lock channel has been provided; this bridge has been fitted with a centre leaf of 6 meters clear span which being counterbalanced can be lifted, to afford passage of boats and the department's dredgers at all water levels, by the operation of a small winch. All steelwork for this lock and bridge was built up in the Royal Irrigation Department's Workshops.

The permanent dam for closing the river has been made up partly from the spoil taken from the barrage pit, and partly from the earth dredged to clear the upstream portion of the new river lock channel down to the designed bed level. Considerable trouble was experienced in the construction of this dam, as the material put into it was almost pure clay, and as such when in contact with water has a constant tendency to slide. The only safe method in constructing a dam of this sort is to encourage the material to slide until it finds its own angle of repose, and this was done in this case, with the result that the final section of the dam is such that it is unlikely to require any attention in the future.

The Irrigation System

Having described the means by which the irrigation system is supplied with water and the works constructed for that purpose, the system itself will now be briefly described. The Prasak south canal system, like most irrigation systems, consists of a main canal, branches from that canal, and distributing channels, which take out from the main canal or the branches, and supply water to the different villages or groups of farms which physical and political conditions admit of being combined into one irrigation area *i.e.* an area which shall receive its water from a common outlet in the distributing channel. There is still another important link in the system, and that is the net work of water courses or ditches which lead the water from the outlet to each separate field, so that one field can receive its water independently of any other field. In the more modern systems in India and elsewhere, it is usual for government to make the water courses at the outset, and deduct the cost of making them later from the farmers on the instalment plan, but in the older systems in India the farmers have made the water-courses themselves, and this though not ideal, is what is at present being aimed at in the Prasak system. Scientific irrigation is quite new in Siam, and the cultivators in general with their co-agriculturists in different parts of the world are extremely conservative, and every care must be taken to avoid any appearance of the new irrigation works becoming a burden on them.

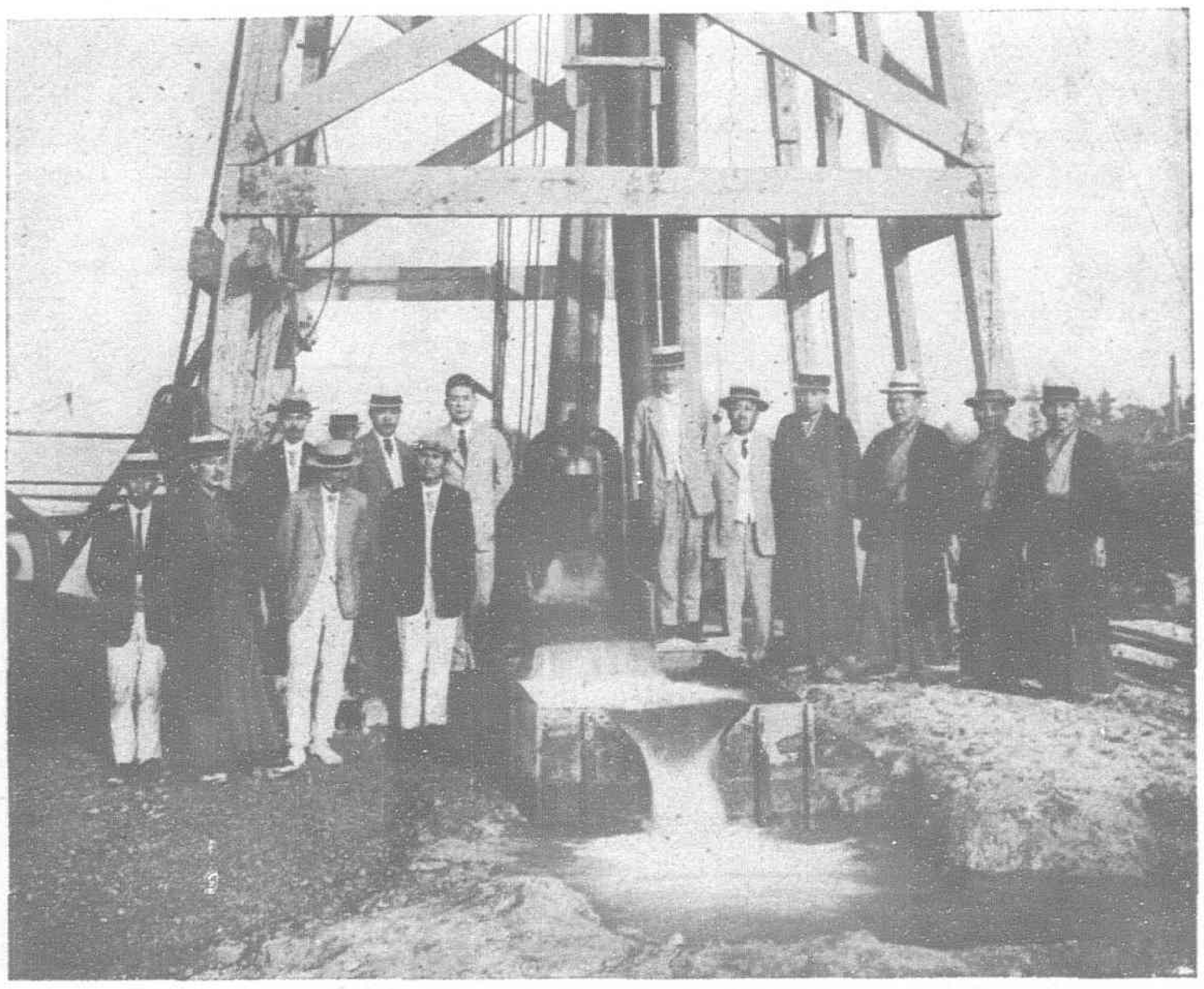
Artesian Wells in the Far East

By Felix F. Wiener, Managing-Director, Wessley & Co., Shanghai

THE consumption of water for domestic and industrial use increases with the progress of civilization. No nation can prosper without an ample supply of pure water. There is no reason to be afraid of using water without boiling, distillation or treatment with chemicals provided such water is obtained from deep artesian wells. Surface water, which is water from rivers and lakes constitutes in most cases the greatest danger to human life and many infectious diseases are caused by the use of such contaminated water. This is also the case with shallow wells, which is mostly seepage water from surface washings. Such shallow wells of which we find numerous in China have their water easily polluted with the first heavy rain; tests made have proven that such water is filled with surface leachings and a large amount of decaying vegetable matter. It is impure water.

It is quite remarkable that there are still people who are ignorant of these facts and continue to be satisfied with wells drilled just deep enough to obtain water without giving any thought to their location and condition. Shallow wells may carry easily the filth of buildings in the neighborhood and the water which is then pumped to the surface contains harmful bacteria which propagate dreadful diseases.

Water from deep artesian wells contains no harmful bacteria as the result of natural, subterranean filtering. It has a pleasant, refreshing taste and it can be used for drinking purposes without boiling or distilling. It contains all the ingredients beneficial to the human organism. It is, therefore, quite safe to use such water for drinking or cooking even when epidemic diseases are prevalent.



Dai Nippon Brewery, Korea

The following analysis was made of water taken from an artesian well drilled by the Japan Artesian Well Co. in West Soochow Road, Shanghai.

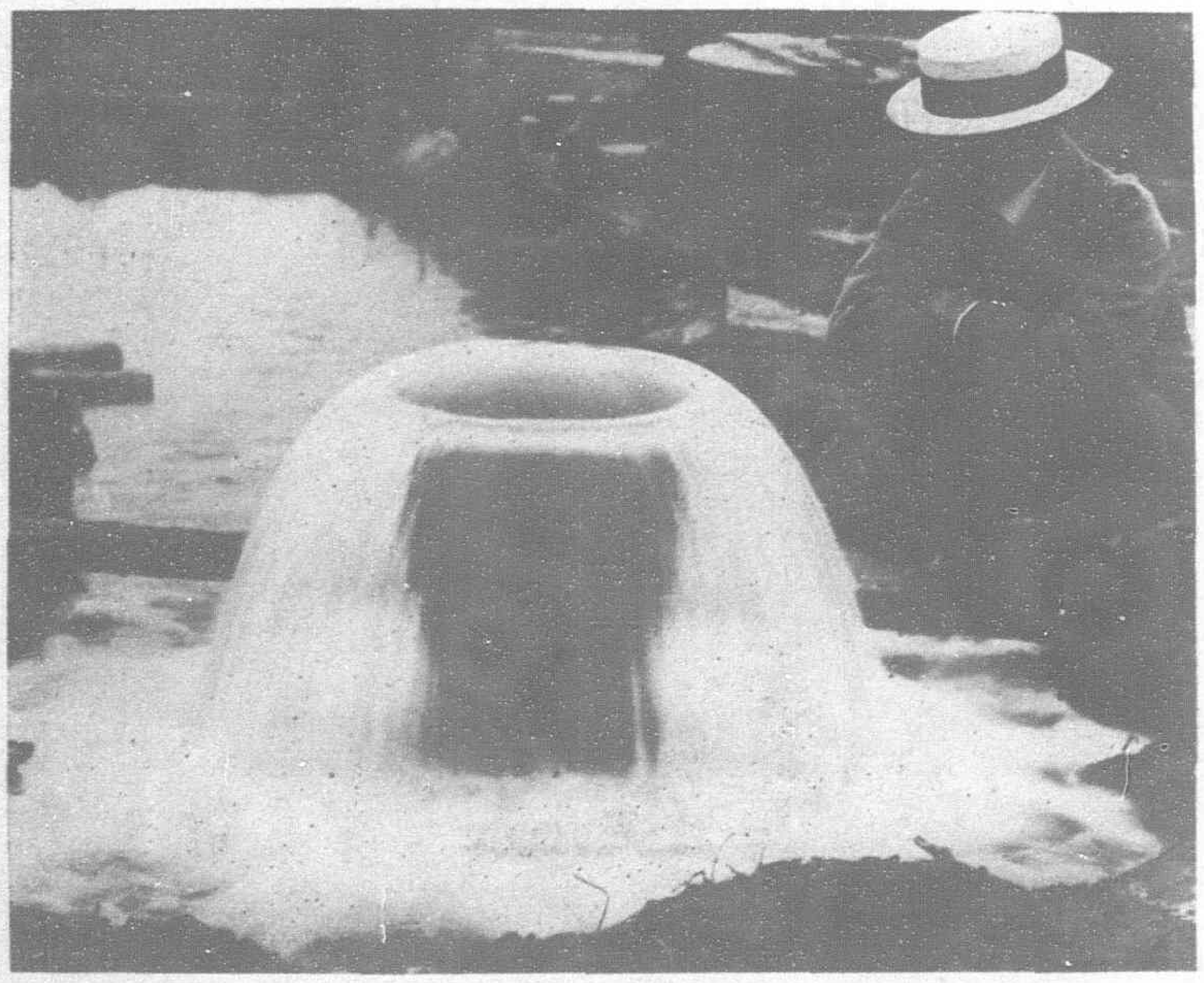
Total hardness	21.280	(German system)
Temporary hardness	15.12°	„ „
Permanent hardness	6.16°	„ „
Total solids	581.00	(m. gs. number in 1 litre)
Chlorine	159.75	„ „ „ „
Lime	164.5	„ „ „ „
Magnesia Oxide	34.57	„ „ „ „
Iron	5.51	„ „ „ „
Silicious matter	26.30	„ „ „ „
Sulphur as (S. 03)	3.02	„ „ „ „
	7.54	„ „ „ „
Free Ammonia	0.028	„ „ „ „
Albuminoid-Ammonia	Trace	„ „ „ „
Nitrate	0.044	„ „ „ „
Nitric	Trace	„ „ „ „
Copper	None	
Lead	„	
Carbon Peroxide	118.8	

The temperature of deep well water is the same throughout the year, no matter whether the well is in hot or cold regions; it is cool in summer and warm enough in winter to make it excellent for daily use. It never freezes.

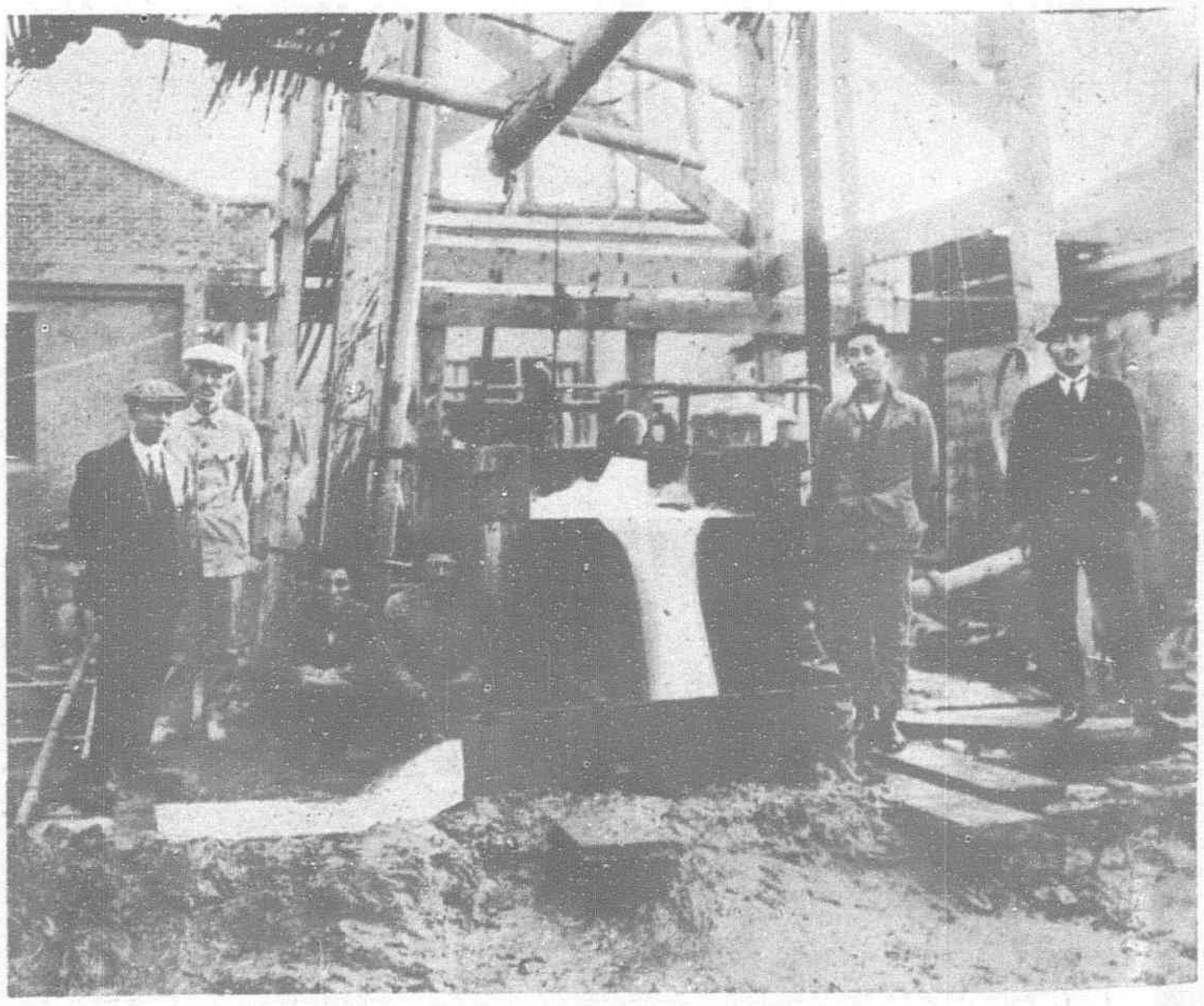
The fact that artesian well water is free from the influence of the weather makes it ideal for regular supply, while so-called surface and rain water vary according to the weather and is readily polluted by rain or snow and may subside with a prolonged drought.

In the Tientsin floods of 1917, the only source of water supply in the British Concession was from artesian wells.

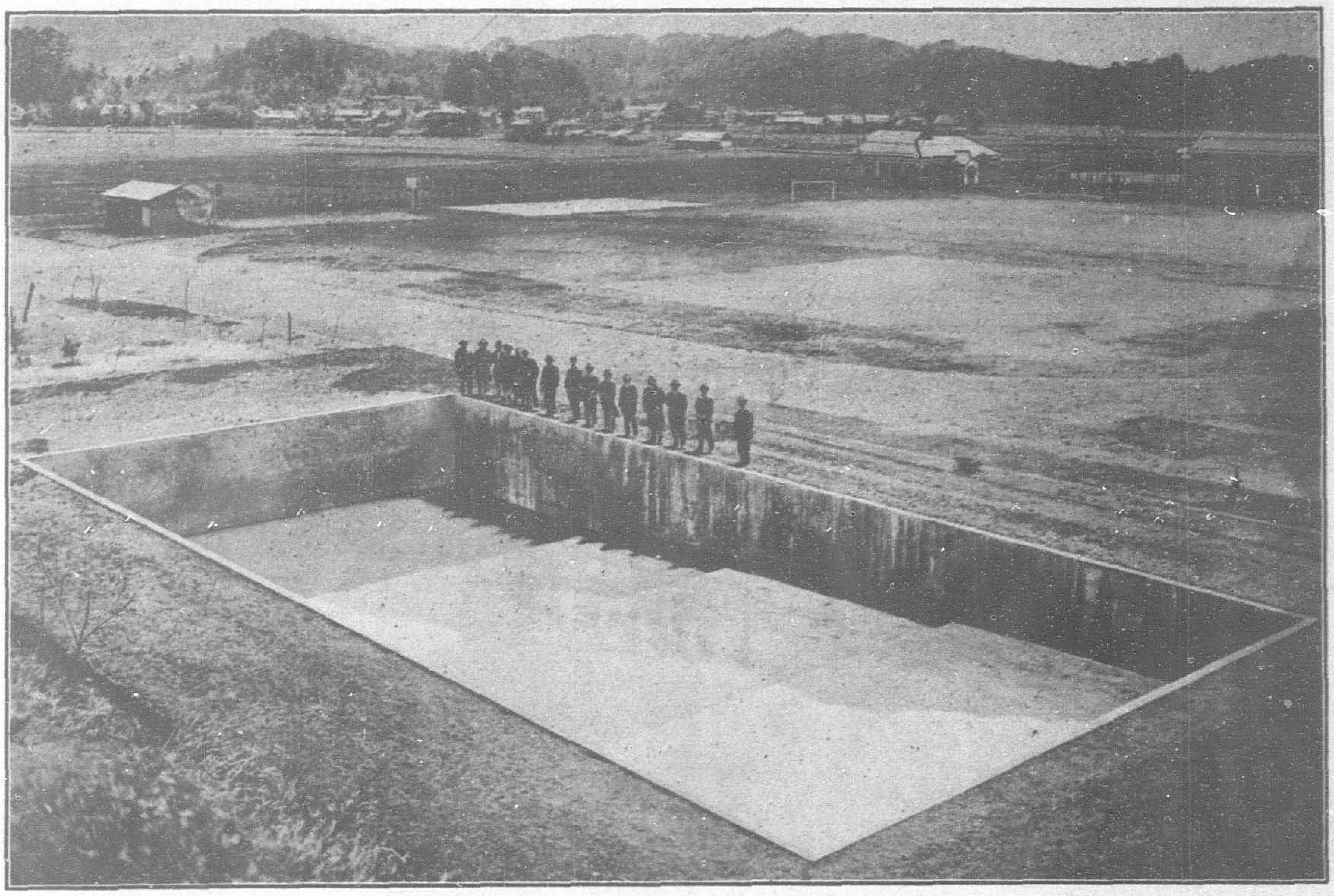
The investment in artesian wells is very much less than that needed for water works with pumping and filtration plants. It is much more economical and safer to drill wells for the supply of city water than to be forced to construct long pipe lines from the water works to the consumer. In Shanghai for instance, water is pumped from the works in Yangtszepoo through pipes to the distant consumer



Gushing Well of the Naetsu Works, Nitrate Manure Co.



Nagai Cotton Mill No. 5, Shanghai



Swimming Pool of the Matsue College

in Jessfield Park, although the geological formation is such that Shanghai is an ideal drilling ground for deep wells.

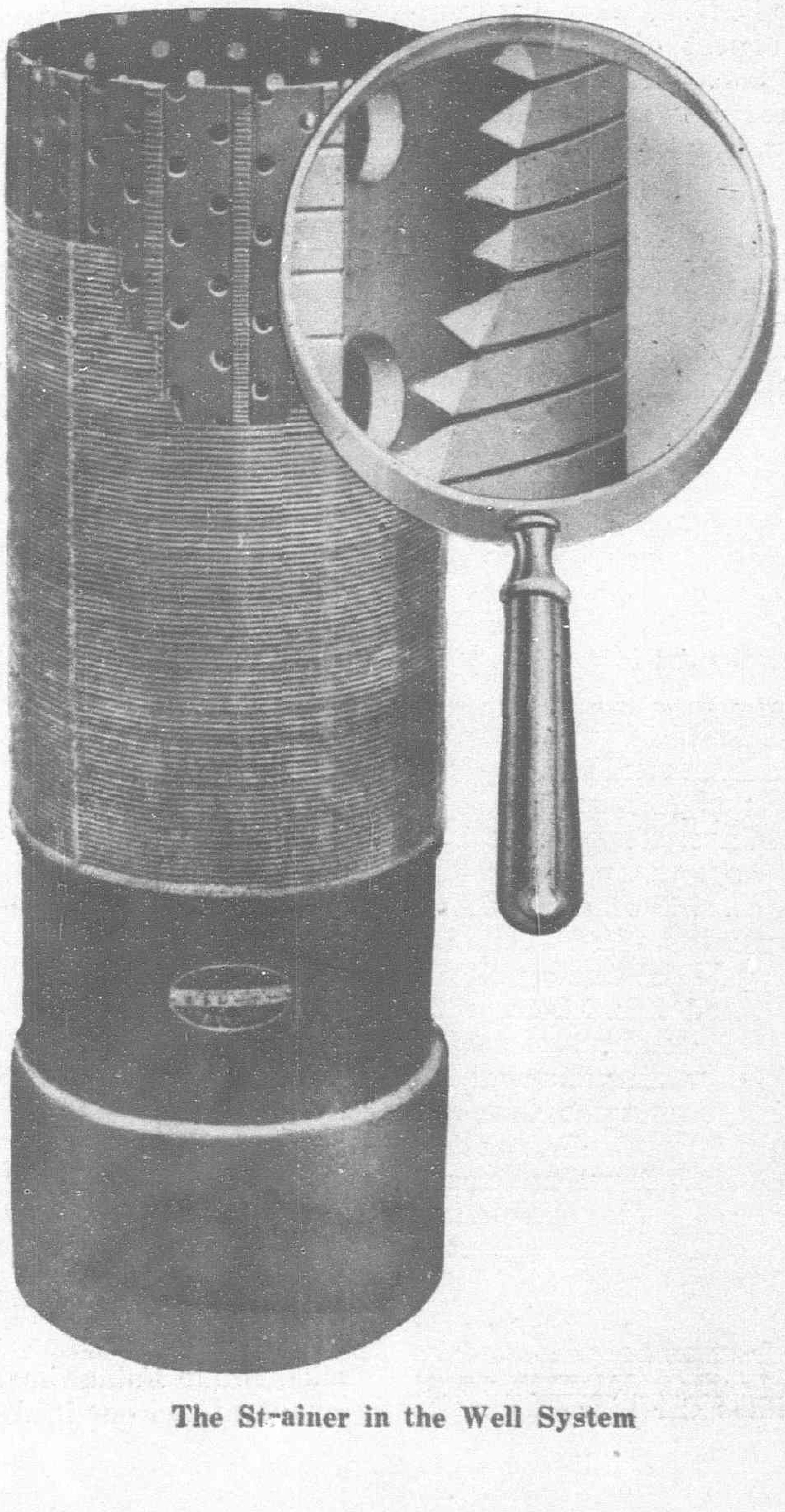
Artesian wells have the great advantage that they can take care of a growing community and of producing water at low cost for industrial establishments. In whatever direction a city extends or wherever an industrial enterprise is started, an artesian well can easily be provided. From an economic point of view an artesian well is a most paying proposition and returns the investment in less than two years' time by the enormous saving against city water.

The question of developing Chinese industries and providing wholesome water for establishments as well as for the workers is of utmost importance. Frequently the fact that no water could be obtained has prevented civic and industrial developments. Water for industrial use does not only comprise that which is used for boilers, heating and cooling, but large quantities are needed for breweries, sugar refineries, sugar and paper mills, tanneries, chemical works, silk filatures, dyeing, bleaching and cleaning establishments, ice and refrigerating plants, and many other branches of industrial activity. Consequently water must not only be plentiful and of good quality, but it must be obtainable easily and inexpensively.

In Shanghai a large number of wells have been sunk, mostly of small diameter, but since the Japan Artesian Well Co. entered the field, they have drilled wells of large diameter with good results, as for instance:

Diameter of Well	Actual Depth	Water in gal. in 24 hours.	Owner
15½″	500	1,000,000	Kiangnan Paper Mill
12½″	500	600,000	,,
12½″	500	760,000	S'hai Silk Spinning Co.
10″	500	560,000	,,
10″	490	560,000	Kun Dah No. 2 Mill
10″	470	600,000	Kun Dah No. 1 Mill
10″	500	600,000	Naigai Cot. Mill No. 5
8″	498	320,000	,, ,, ,, No. 3
8″	495	320,000	,, ,, ,, No. 9

Water is so generally used that one sometimes forgets how important it is. We may mention water for sewerage, for beautifying parks, for making recreation grounds more attractive, for waterways and ponds, for street cleaning for swimming pools, etc. Deep artesian wells will be more generally adopted in the Far East as soon as their advantages become more widely known and recognized.



The Strainer in the Well System

Japan used a primitive method of sinking shallow wells and no attention was paid to scientific developments of sinking deep artesian wells until the Japan Artesian Well Co. entered this field as pioneer in 1913. In the first well that was sunk in Ochiai, in the outskirts of Tokyo, they succeeded in striking water-bearing layers at the depth of 520 feet, producing 8,000 gallons gushing or 1,200,000 gallons by pumping in 24 hours. The water, pure and crystal clear, rushed out like a waterfall. Dr. S. Toyama, head of the Tokyo Hygienic Laboratory, made a thorough test and found the water to be excellent in every respect, in fact, it was much better than the Tokyo city water and was highly recommended as the standard of perfect drinking water.

When the news of their success at Ochiai was published, a great sensation was created and the following is an extract of an article in one of the newspapers at that time:

> "There is always a fear of lack of water supply even when considerable amounts of money have been spent to secure it. The possibility of getting an unlimited supply of water from great depths was often pointed out by scientists, but no one ever dared to prove it in Japan. The success of the Japan Artesian Well Co., is a godsend to our nation. In future we will not only make this method useful for the water supply of our cities, but it will be greatly used for productive industries and will render a great service in the exploitation of the natural resources of our country."

Since the success of the first well at Ochiai, artesian well drilling has been steadily progressing, and last year about one hundred wells have been drilled in Japan.

At the time of the great earthquake in 1923, Tokyo was deprived of its regular water supply for more than a month, and it is still fresh in our memory how people suffered from lack of pure drinking water at that time. Immediately after the catastrophe, the conditions of 42 artesian wells which had been sunk in Tokyo were investigated and it was found that all the wells were in excellent order. Thousands of wells have been sunk in Japan and China by the Artesian Well Co., and all of them are reported to be in excellent condition.

To drill wells correctly, the work has to be done on a scientific basis and careful investigation has to be made of the geological conditions. Where the drilling of wells has been a failure it was almost invariably due to the drillers who lacked the experience to recognize the geological evidence about them.

No good can be done by carrying wells to excessive depths. On the other hand, common experience proves that wells that have been sunk only to their high water horizon will become dry when the water level sinks. This is a frequent occurrence in chalk strata in which there is a very wide difference between the highest and the lowest water levels. A well drilled during a high water period will run dry when the lower water power period approaches. The selection of the most suitable site is also of greatest importance and such selection can be compared with the planning of an architect or the diagnosis of a physician and no permanent success can be obtained unless an exact survey based upon extensive geological knowledge and long experience has to be made.

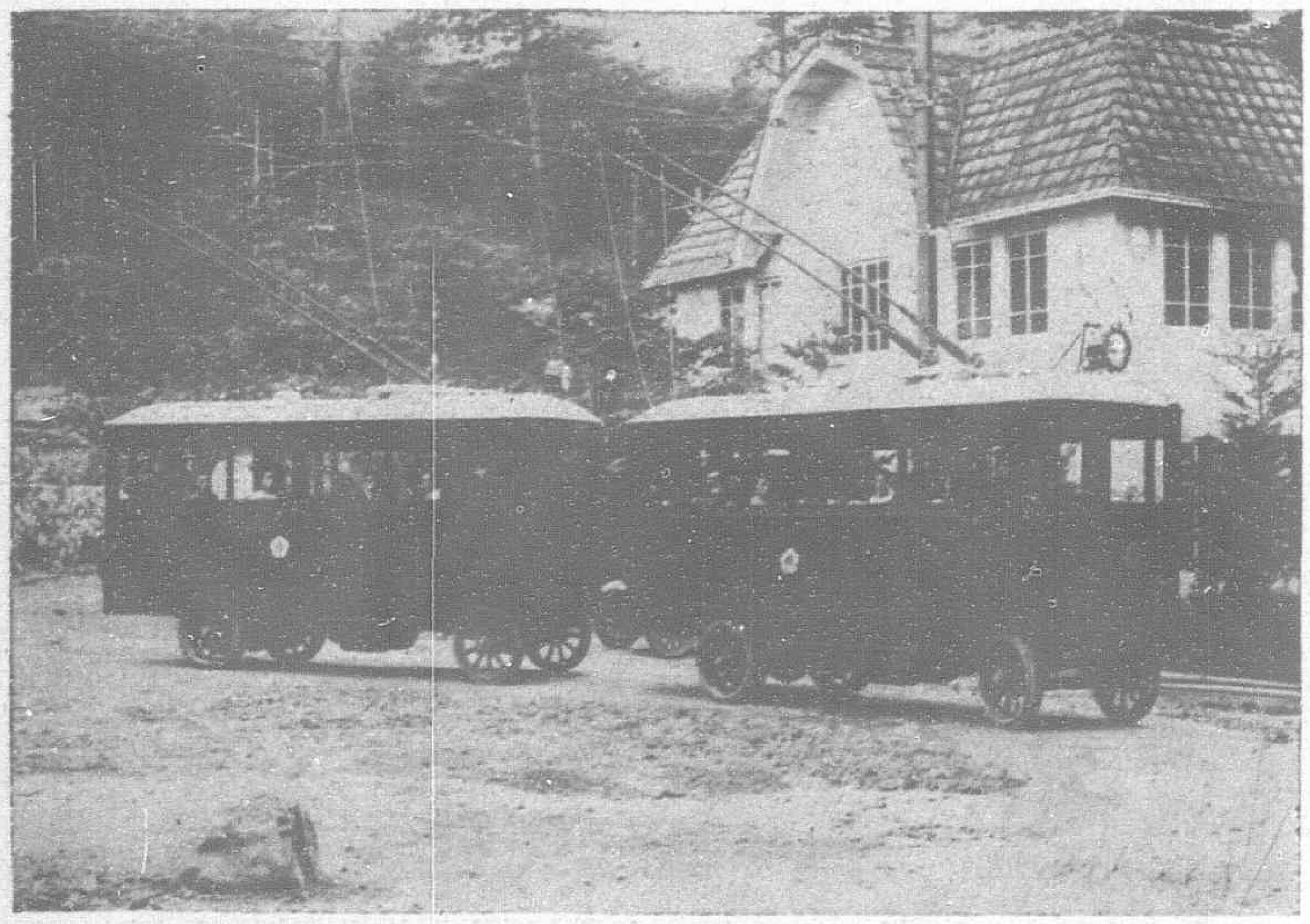
For deep and large wells, that means such with 10-in., 12½-in. and 15½-in. diameter, the Rotary System has proven to be the best possible. With a Rotary apparatus wells to a depth of several thousand feet can be drilled if that is necessary. In drilling a deep well, clay is applied under hydraulic pressure to prevent the collapsing of the drill-hole during or after the drilling and enable the well to be of even size from top to bottom. This is a very important feature. After many years of research and practical experience, an indestructable strainer has been perfected by the Japan Artesian Well Co. who claim it to be the most effective of all devices for the same purpose. It has a great inlet capacity so that wells give a maximum water yield with a minimum of friction. Another important matter in producing fine artesian wells is the cleansing of the water-bearing strata by which all fine sand in suspension is absolutely eliminated. It has been found that to safeguard the production of the well, the casing pipes should be of mild steel instead of cast or galvanized iron.

The Shinhanayashiki Railless Car Line

As the pioneer of a railless car line in Japan, the Shinhanayashiki railless car line was recently opened by the Hanshin Highspeed Electric Railway Company for a distance of 1.3 kilometers between Shinhanayashiki and Hanayashiki. Though undertakings of this nature had been planned by several other concerns, including the Tokyo Municipal Electricity Bureau, before the Hanshin Highspeed Electric Railway Company was first granted government sanction, none of their schemes has been realized. As a matter of fact, there had been no regulations governing a railless car line in 1925, when the Company filed an application with the Department of Home Affairs for permission to open a railless car line. After a prolonged consideration of the local authorities, however, it was decided that the regulations governing motor car transportation be applied to the enterprise, and the Company has thus obtained the franchise to construct the car line.

Located near the Hanshin Highspeed Electric Railway line which connects Osaka and Kobe, Shinhanayashiki is a newly opened pleasure resort with a hot-spring and a recreation ground. In addition, there are rows of houses under construction by the estate owner, the Shinhanayashiki Hot-spring and Estate Company. Therefore, it has been planned by this Company to operate a railless car line between the two stations, Shinhanayashiki and Hanayashiki in order to give facilities for the residents as well as for excursionists visiting the resort in a hilly district.

The road on which the cars are in operation has a width ranging from 7 to 10 meters. The central part of the road where the cars run is concreted for a width of 2 "ken." The average gradient of the road is 1 in 10, and the maximum gradient, 1 in 7.



Cars in Operation for the Railless Car Line

The cars, two in number, were manufactured by the Hidachi Engineering Works at a cost of Yen 15,000 each. Following are the principal dimensions of the two cars: Total length 18 ft.; Length of the inner part, 17 ft. 3¼ in.; Total wideth, 6 ft. 2½ in; Width of the inner part, 5 ft. 4¼ in.; Total height 9 ft. 10 in.; Height of the inner part, 6 ft. 3¼ in.; Total wheel base, 11 ft.; Diameter of wheels, 32 in.

Interior of the Car

The cars have accommodation each for 28 passengers with 22 seats. Each car is equipped with two 20 h.p., 500 volt, 1,500 r.p.m. direct current motors. In addition to one controller installed, there are four brakes, namely electric brake, contraction system foot brake, expansion system hand brake and center foot brake.

Trolley wire suspension is of the compound catenary system. As supports, steel poles, and of German make, are erected imbedded in concrete on both sides of the road at an interval of 32 meters.

The power required for operating the car line is supplied from the power station of the Hanshin Highspeed Electric Railway Company. The minimum quantity of consumption is 5,000 k.w.h. per month.

Following the completion of this railless car line, applications for government sanctions for the same enterprise are now filed one in Osaka, two in Fukushima, eight in Ibaraki, one in Ishikawa, one in Yamanashi and one in Aichi Prefectures respectively.

The 17,000 S.H.P. Twin Screw Turbo-Electric Liner "Viceroy of India"

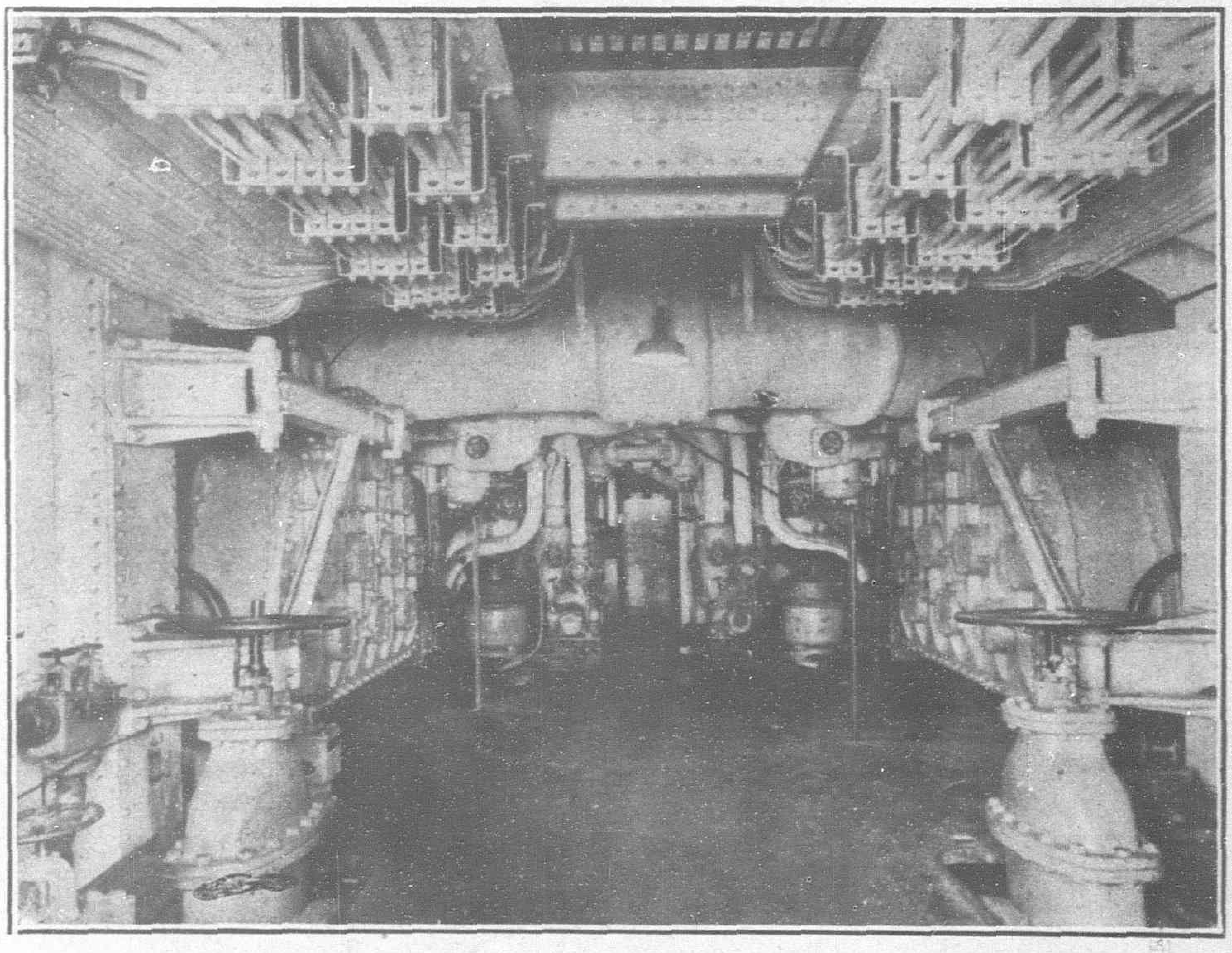
THE *Viceroy of India* is the first large passenger liner to be fitted with high pressure steam and turbo-electric propulsion equipment in this country, and is the first ship of notable size on which the arrangement of single berth 1st class rooms has been carried out. Leading particulars are :—

Length	612 ft.
Breadth	78 ft.
Depth	82 ft. (to the uppermost of the nine decks).
Speed	19 knots.
Tonnage	19,700
Passenger Accommodation	415 in 415 rooms, First Class. 260 in 100 rooms, Second Class.
Total Crew	420.

Decoration of the public rooms has been carried out by Messrs. Waring & Gillow Ltd., and the ventilation throughout the ship is on the Thermotank principle. Lighting is effected by means of Mazda electric lamps, over 6,000 of these having been supplied. The winches, windlass, capstans, engine room pumps, refrigerating machines, and forced draught fans, are electrically driven on the "Austin" system, and the whole of the heating and cooking is done electrically. The electric installation has been carried out by the Builders.

General Description of Equipment

The main propelling machinery consists of two separate Turbo-Alternators, each with its own condensing plant and auxiliaries, supplying current to two slow speed synchronous motors which are coupled direct to the twin propeller shafts, a contactor cubicle being provided to control the current from the alternators to the propulsion motors.

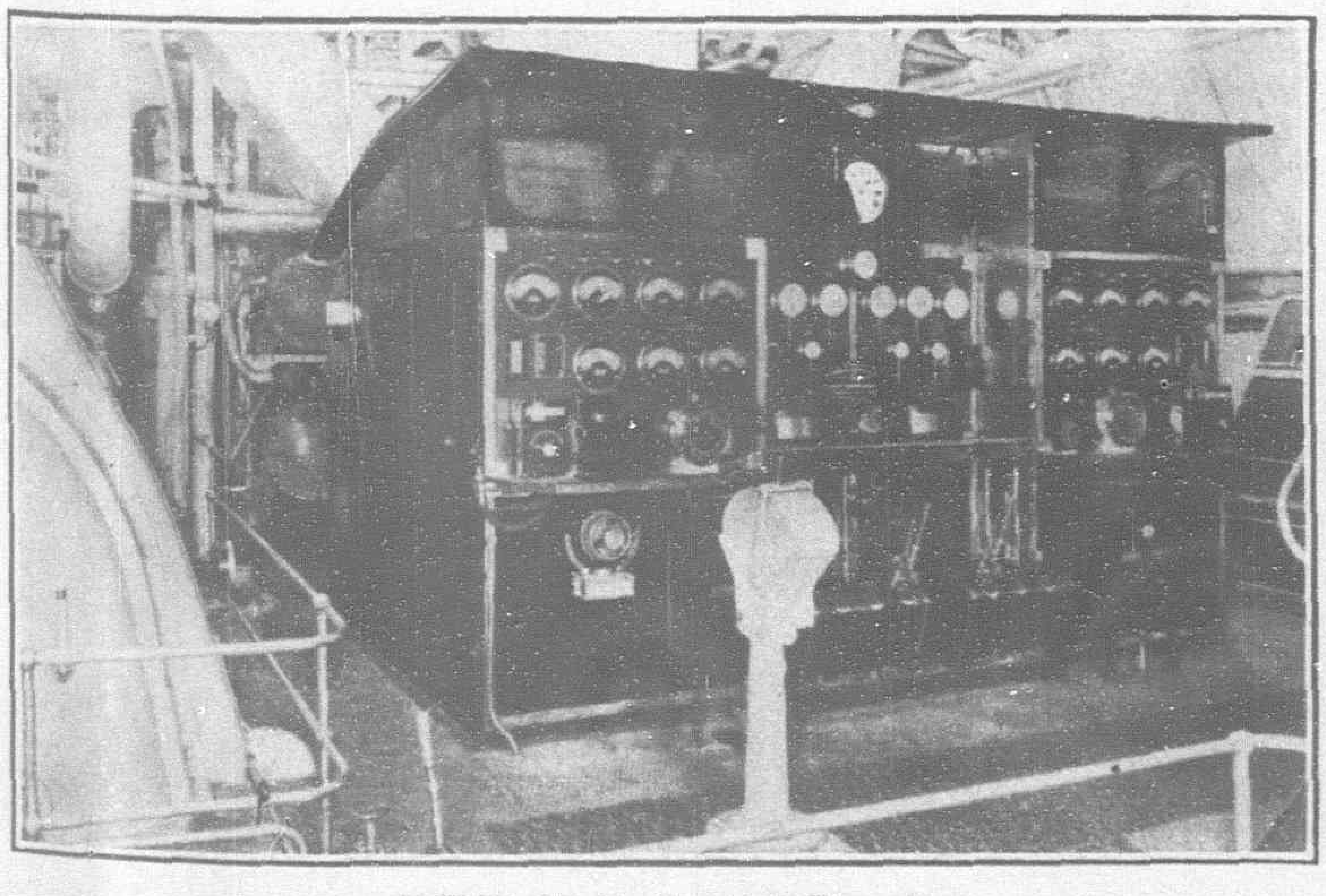


Condensers for Main Turbo-Alternators, Showing B.T.H. Verticle Spindle Motors Driving Extraction Pump

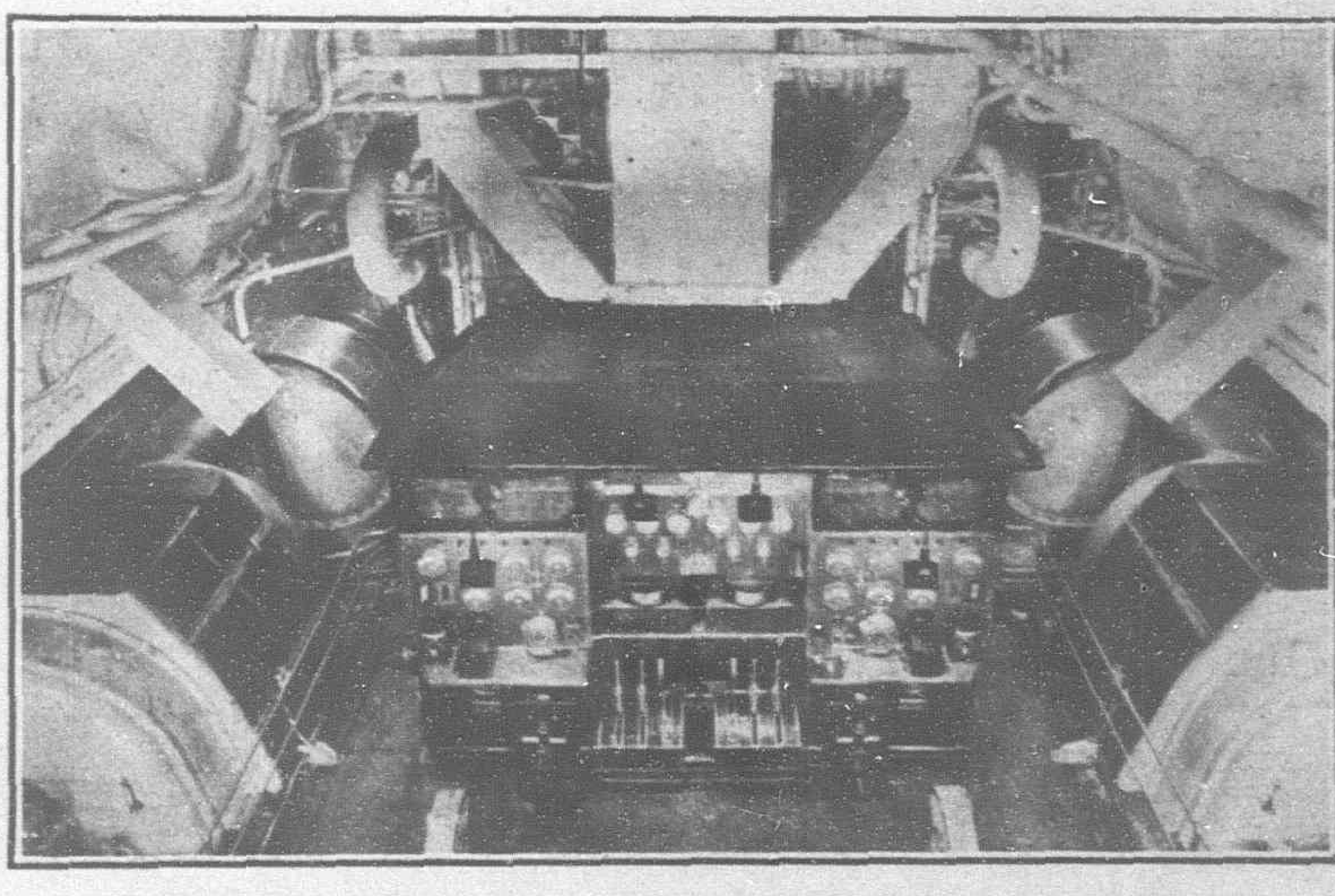
At reduced powers one turbo-alternator only is required for supplying current to both motors, the second turbo-alternator standing in reserve. Thus maximum economy in fuel both at full and reduced power is obtained, which is a great advantage in a vessel which does part of its voyage at less than the maximum speed and power. The reserve power can be quickly brought into use when required, as, for example, if the ship be delayed by heavy weather—particularly important for a mail-carrying vessel.

Variation in propeller speed in either direction is obtained by varying the turbine speed, and is directly under the control of the engineers at the control panel. The direction of rotation of the propeller is changed by reversing the connections of two of the three phases leading from the alternators to the motors ; this is accomplished by means of contactors operated by levers located on the control platform. The turbo-alternators always rotate in the same direction and, with both in operation, the speed and direction of either propeller may be varied irrespective of the other. When one turbo-alternator is used for driving both propulsion motors, both motors operate at the same speed ; they may, however, rotate in the same or in opposite directions.

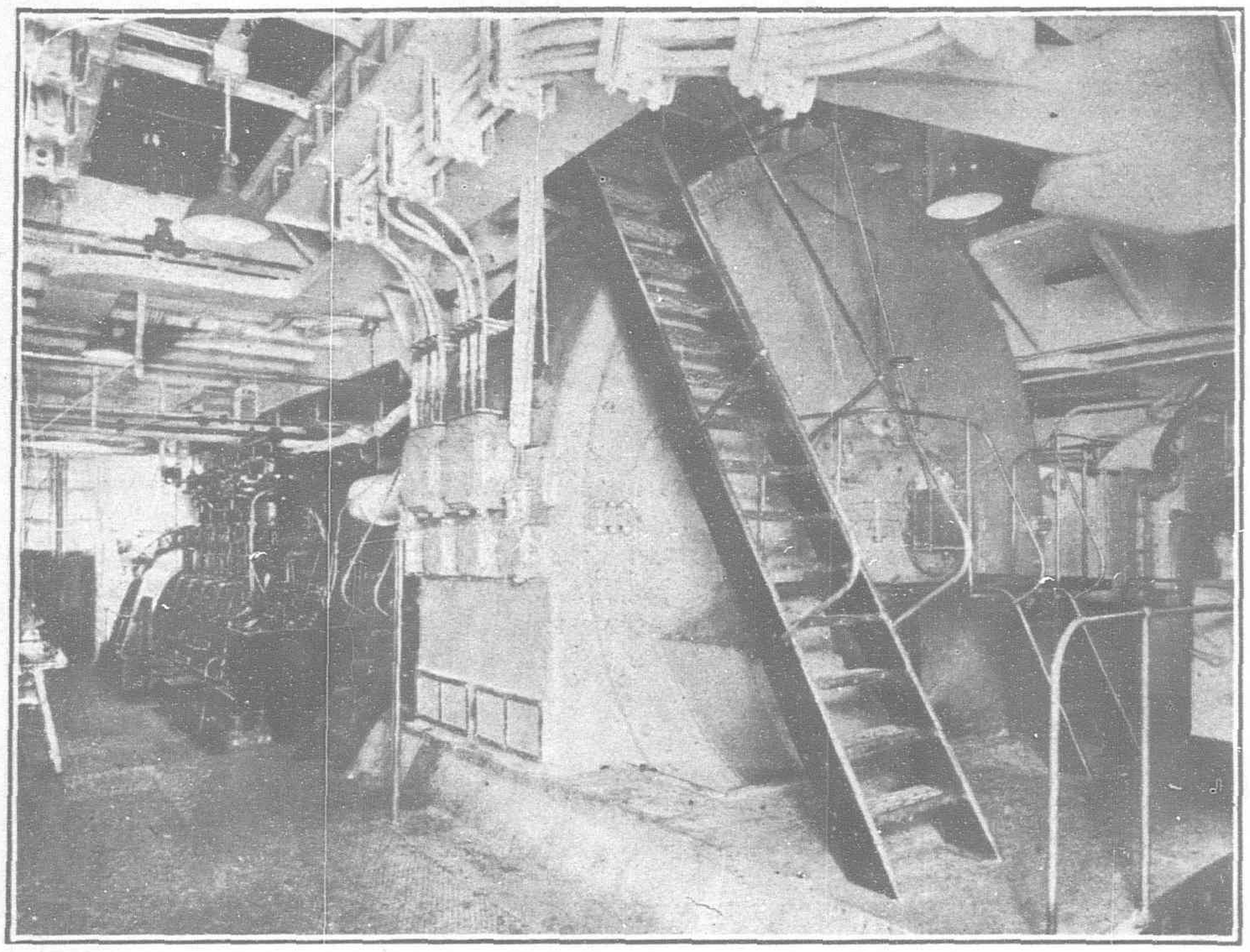
When starting or reversing, the turbo-alternators operate at approximately one-fifth speed or below, and the propulsion motors are brought up to a corresponding speed as induction motors. The field windings of the alternators are temporarily over-excited



B.T.H. Main Control Board



B.T.H. Main Turbo-Alternators and B.T.H. Control Board



One of the B.T.H. Propeller Motors and in the Background, one of the Diesel Engine Driven B.T.H. Auxiliary D. C. Generators

during the reversing and accelerating period to bring the propulsion motors up to speed, and to bring them almost into synchronism; the motorfields are then excited to bring the motors fully into synchronism, and finally the alternator field strength is reduced to normal.

A separate motor-driven exciter set supplies excitation to each turbo-alternator; change over links enable the exciters to be interchanged, if required.

Owing to the large demand for electric current for heating, lighting, ventilation and cooking, four auxiliary turbo-generators each developing 500 k.w., as well as two solid injection oil engine-driven generators, each of 165 k.w., are installed.

The whole of the electrical equipment was manufactured by the British Thomson-Houston Co. Ltd., Rugby.

Steam for the turbines is supplied at 350 lb. per sq. in. gauge pressure and 700 degrees F. total temperature by six Yarrow boilers, situated in two separate stokeholds. Four boilers are placed in the aft stokehold and are of sufficient capacity to enable the forward stokehold to be entirely closed down when the vessel is steaming at 16½ knots. In addition to the Yarrow boilers, there are also two cylindrical boilers in the forward stokehold for supplying steam in port.

The air required for forced draught is supplied by six electrically driven fans, the motors being of the Austin constant current type, giving a large speed variation.

The boilers are arranged for oil fuel firing on the "Clyde" oil fuel system, manufactured by the Builders. All oil fuel plant, including pumping and heating units, transfer pumps and filters are placed in two separate pump rooms, situated between the forward and aft stokeholds. All oil fuel pumps are electrically operated. Some 2,300 tons of oil fuel are carried in 22 tanks surrounding the boiler compartments, the tanks being filled from a central station on each side of the ship, and the quantity of oil in each tank may be measured at any time by means of Negretti and Zambra's mercurial gauges.

Feed water for the boilers is supplied by two Weir turbo feed pumps, and any loss of feed water is made up form fresh water in the double bottom tanks, which is purified by being evaporated in a low pressure evaporator. The feed arrangements are designed on the Weir closed feed system, and the feed heating is in three stages, there being one surface heater on the discharge side of the water extraction pumps and two surface heaters, one I.P. and one H.P., on the discharge side of the turbo feed pumps. Steam for the heaters is bled from the main turbines and exhaust from the feed pumps, and the feed temperature will be about 300 degrees F.

The two circulating pumps for the main condensers are each driven by a variable speed electric motor, and are cross connected to allow one pump to circulate both condensers.

All auxiliary machinery, with the exception of that driven by Austin constant current motors, is driven by 220 volt D.C. motors. For the supply of current to the Austin motors, three motorgenerators are placed on the port side of the engine room.

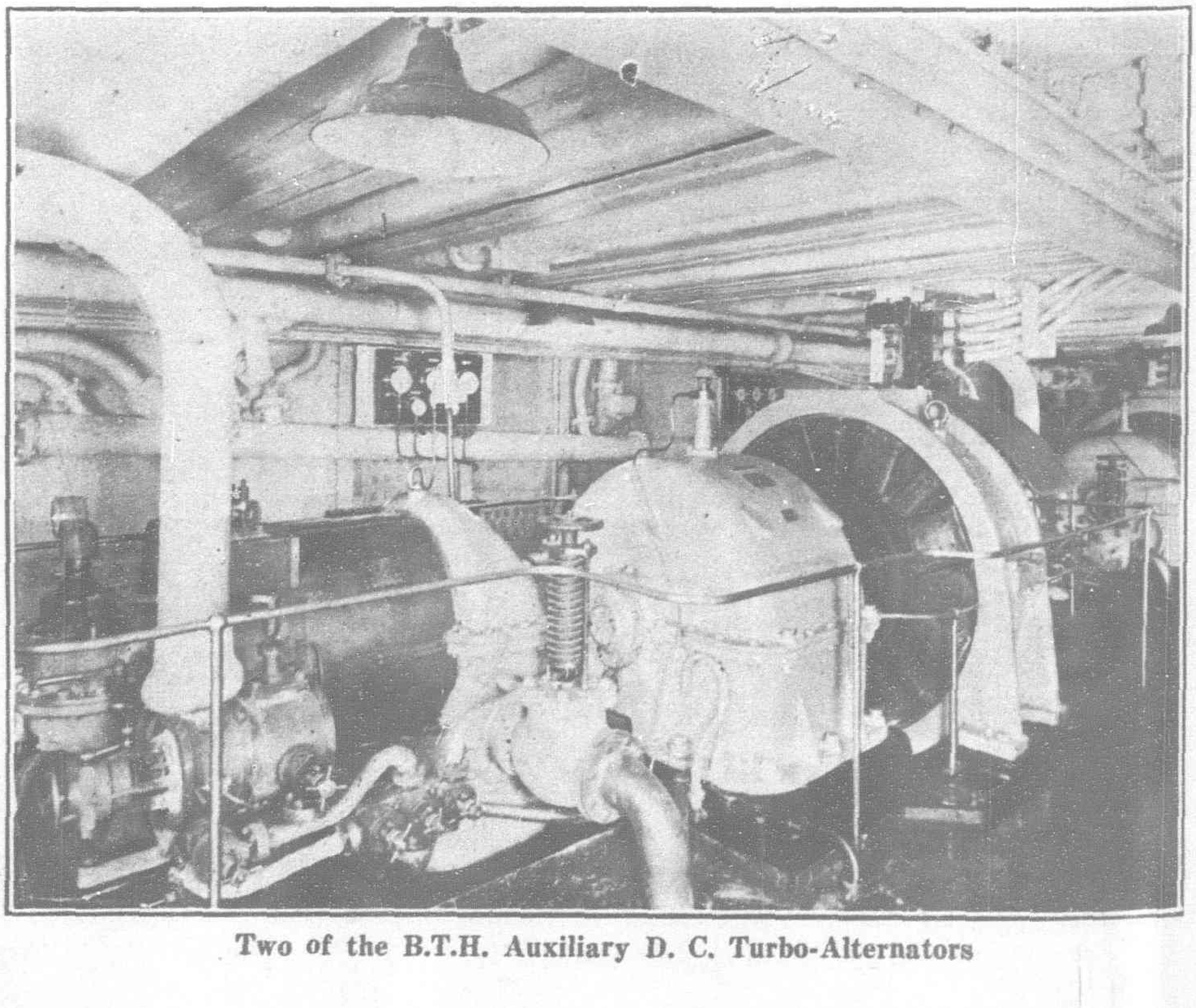
The main switchboard (by the British Thomson-Houston Company) is at the aft end of the engine room, and within view of the main starting platform, which is situated between the two turbo-alternators and above the main propelling motors. Also at the aft end of the engine room on the port side, is situated the engineers' workshop equipped with lathe drilling and grinding machines, all operated by independent electric motors. The ventilation of the engine and boiler rooms is of considerable importance in a vessel using highly superheated steam and sailing in hot climates, and eleven large ventilators, each fitted with mechanical ventilation, are installed for this purpose.

An electrically operated lift is fitted between the starting platform and the boat deck where the Engineers' accommodation is arranged.

The Electrical Control of the Propelling Machinery

The main propelling equipment may be classified in three sections as follows :—

(*a*) Two Turbo-Alternator Sets, Maximum rated, 9,000 k.w. 2,690 rpm, 2,720 volts, 3-phase. (Maximum speed rating 6,536 k.w., 3,110 rpm, 3,150 volts, 3-phase).



Two of the B.T.H. Auxiliary D. C. Turbo-Alternators (*b*) Two Synchronous propulsion motors, each 8,500 Shp' 109 rpm, 3,150 volts, 3-phase.

(*c*) One Control apparatus group, and also the necessary exciter sets and ventilating fans.

At the forward end of the control cubicle are the isolators and tie switch, each being triple pole, and operated by handwheels. The isolators enable each alternator to be electrically connected to its respective propeller motor, or either of the alternators to be connected to both propeller motors.

The controls are interlocked so that damage cannot be done to any portion of the equipment when manoeuvring by an unskilled operator. At the same time indicating instruments are provided by means of which an intelligent operator can carry out orders in a very short space of time with a minimum of manual effort.

Operating Levers.—For each propeller three controlling levers are provided for operating contractors and speed settings of the governor :—

(*a*) A direction lever

(*b*) A field and speed controlling lever

(*c*) A dead slow speed lever

These are all mechanically interlocked to ensure correct operation. Thus, the direction lever (*a*) can only be moved if the manoeuvring lever is at "stop." The field lever (*b*) in its first half of travel operates field contactors in the correct sequence for starting the motor. For the remaining half travel the control is on the governor of the turbine, the speed setting of which it varies between one-fifth and full speed. A micrometer adjustment is also provided on this lever which permits fine speed settings. Since the same lever is used for both purposes, all manoeuvring must take place with the governor setting at one-fifth speed. This lever is interlocked with the slow speed lever (*c*), so that the latter cannot be used for reducing speed below one-fifth, unless (*b*) is in its slowest speed position and correspondingly lever (*c*) must be at its maximum speed position before the speed can be increased with lever (*b*).

The whole of the control cubicle is "mistake-proof" and, with the special keys, incorrect switching is impossible ; for example, whenever it is necessary to open or close an isolator or tie switch it is essential to have all contactors in the open position. A special lock is therefore fitted to the levers, the key of which is also used to free the isolators ; the reversing and field levers must be "off" and locked in this position to release this key.

An electrical interlock prevents the circuit breaker on the main D.C. switchboard from closing unless the field levers are both in the "stop" position. This prevents the fields being switched on to the machines after a shutdown on the D.C. side, without bringing the field levers to the "stop" position and starting up again in the usual way.

Starting.—The simplicity of the control is seen by reference to the operations which have to be performed to start the propeller motors :—

(1) Place the "Slow Speed" levers in the "OPEN" position.

(2) Place the Direction Levers "Ahead" or "Astern," as required.

(3) Move the "Field" levers to the following positions :—

  (*a*) To Notch No. 1, and lift the side latch. Watch the speedometer until the two pointers are opposite each other.

  (*b*) Move to Notch No. 3. The motor should immediately pull into synchronism. As soon as the motor synchronises lift the side latch and pass on to the "run" position. (Notch No. 4).

(4) Adjust the speed as required.

It is evident that the bold policy of Lord Inchcape in adopting turbine electric propulsion for a large passenger vessel, has enabled the P. & O. Company and the builders to take a further step forward in the search for perfection in the interests of passengers and of economy.

Chinese-Made Radio Sets

The progress of radio and wireless in China has been rapid in the last four years. Many Chinese radio companies are now manufacturing transmitting and receiving sets for family use, which compare favorably with those imported from abroad. As the home-made sets are sold at cheap prices foreign apparatus are being displaced from the market.

Of the numerous Chinese radio manufacturers at least four are noteworthy. They are the Chinese Government Radio Works, 862 Avenue Haig, which is a Government organ ; the Trio Company at the end of Route Fergusson ; the Shanghai Electric Company, 85 Nanking Road ; and the China Scientific Instruments Company, 20 Museum Road. There are many small concerns who assemble the various parts bought from abroad into complete sets. Some others manufacture small parts themselves.

The four companies mentioned above manufacture every part of a radio instrument except the tube and the high-tension generator. These are generally bought from foreign countries because to manufacture them requires a large factory and considerable capital. It is thought, however, that Chinese will make these as well, when the demand warrants the installation of elaborate machines. Chinese radio engineers educated abroad have been manufacturing tubes and generators in factories in other countries and they are prepared now to embark on large scale manufacturing in China.

The four Chinese radio manufacturers mentioned above are the oldest ones in the field. When their products were shown on the market foreign importers immediately reduced their prices, but as the cost of foreign equipment is much higher due to expensive labor and materials in other countries, they have little chance to compete with Chinese manufacturers in the popular market, although imported sets are still sold.

Two years ago when the short-wave wireless transmitters were introduced into this country, the Chinese Government immediately took steps to develop this equipment for communication purposes. In cities in the interior where the telegraph wire had been cut by outlaws wireless transmitters were installed.

The embargo on radio equipment enforced by the Chinese Government since foreign dealers began to import receiving sets and transmitters into China, was lifted on February 1 of this year through the joint recommendation of the National Construction Commission and the Ministry of Finance. At present a 12½ per cent import tariff is levied on radio equipment and accessories.

The China Scientific Company having offices and laboratory at 20 Museum Road, was started four years ago with a small capital. It was at first an individual enterprise but has since grown into a corporation. Trained engineers have been engaged, and the company supplies instruments to the various military headquarters, Government organs, Chinese steamship companies and also some foreign establishments. It also undertakes to repair any kind of wireless sets. Mr. Robert Ting, who started the enterprise, is the Chief Engineer as well as the General Manager.

The Government Radio Works on Avenue Haig was started in May, 1927, under the auspices of the military headquarters of Nanking, which appropriated regular sums of money for its maintenance. In November 1928 the works was handed over to the National Construction Commission, then known as the National Council of Reconstruction. It is now being conducted on a commercial basis with a monthly output of 20 complete sets. The plant is now valued at $90,000. Dr. J. K. Yen is the Chief Engineer and Mr. Z. S. Yu is General Manager.

The Trio Company caters chiefly to Government bodies. The works and the showroom are located together on Route Fergusson, and a growing business is transacted there. The Shanghai Electric Company has showrooms on Nanking Road and works on Scott Road. Besides manufacturing radio sets the company also makes various electric appliances.

The Perting Hydro-Electric Installation of Tin Bentong N.L.

By Gordon Moffitt Peacock and Charles Ingle Robinson

TIN Bentong N.L. was formed at Melbourne, Victoria, in 1913 for the purpose of treating the stanniferous gravels of the Bentong River with a bucket dredge. The land acquired under sublease by the promoters had long been mined by Chinese, both open cast and by shallow shafts.

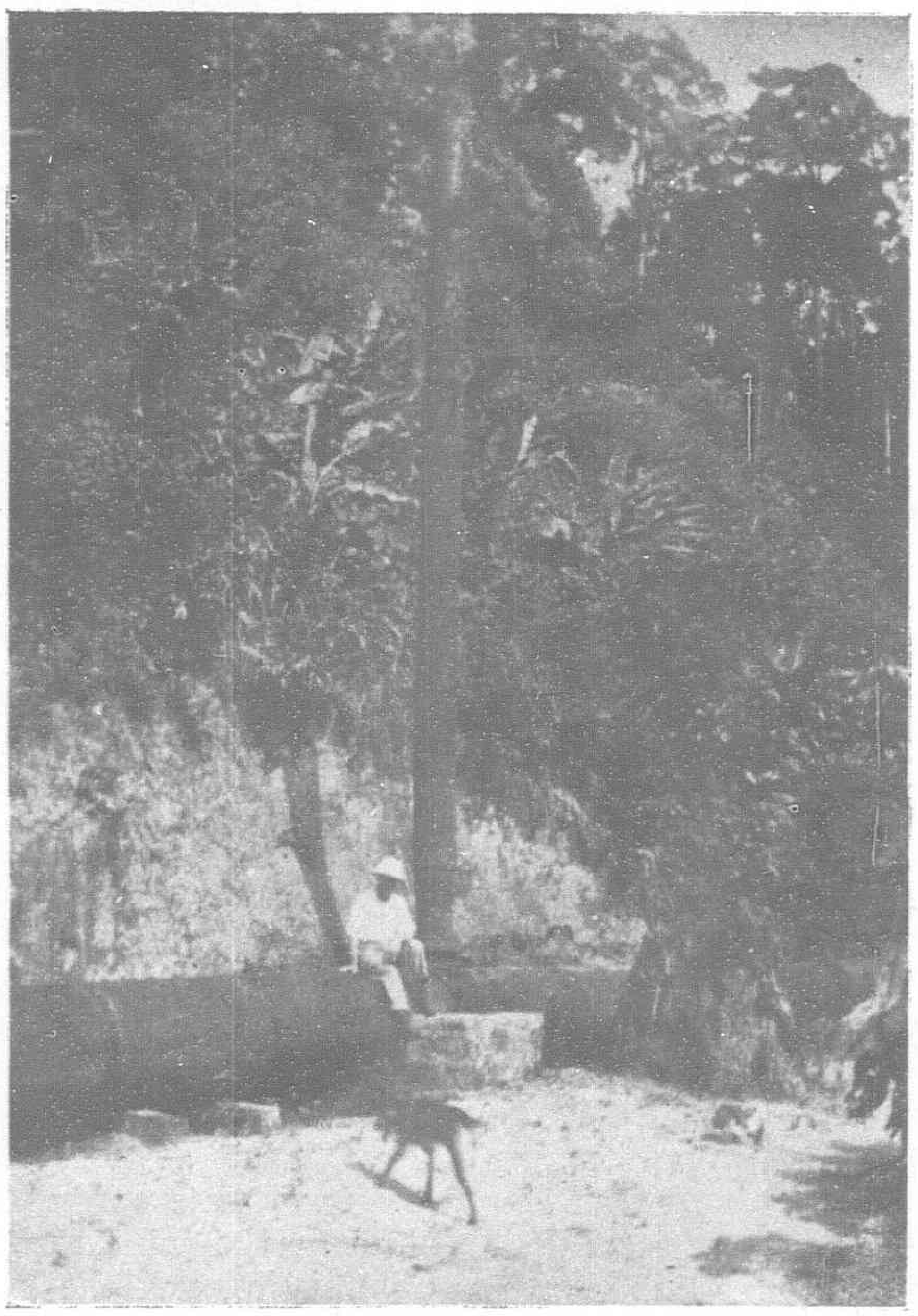
It was decided to establish a hydro-electric power station on the Perting River, an intake dam being constructed across the stream in the foothills, and power house where it debouches from the main range on to the plain. The river carried an extremely heavy solid load, as tin ore is generously distributed through the decomposed granite of the range, and had long been worked by ground sluicing, all the debris from the ground cut being discharged to the river system. The number of miners at work is nearly one thousand.

In issuing the Water Licence for use of the Perting River, the Pahang Government made it clear that no guarantee could be given as to future solid load, on account of the hill mining interests involved. The volume of water available was deemed sufficient to permit reduction of solids to a degree that would avoid serious trouble in the water motor.

The catchment area above the intake is about 30 square miles :—

The mild steel pipe line, fittings and power plant together with the dredge material came from the U.S.A. The dredge is by the Bucyrus Co. and is the only spud dredge in the F.M.S.

The head works are situated about 6 miles West of the Bentong Town of which 5 miles consists of Government road, which terminates at the foot of the Range. The last 2 miles of road follow the left bank of the river. The dam was completed on January 1, 1917, and the Power Station on May 1, of same year. The intake consists of a low dam across the granite bed of the river and skimming wall running upstream, all in rubble masonry.



Air Vent Pipe

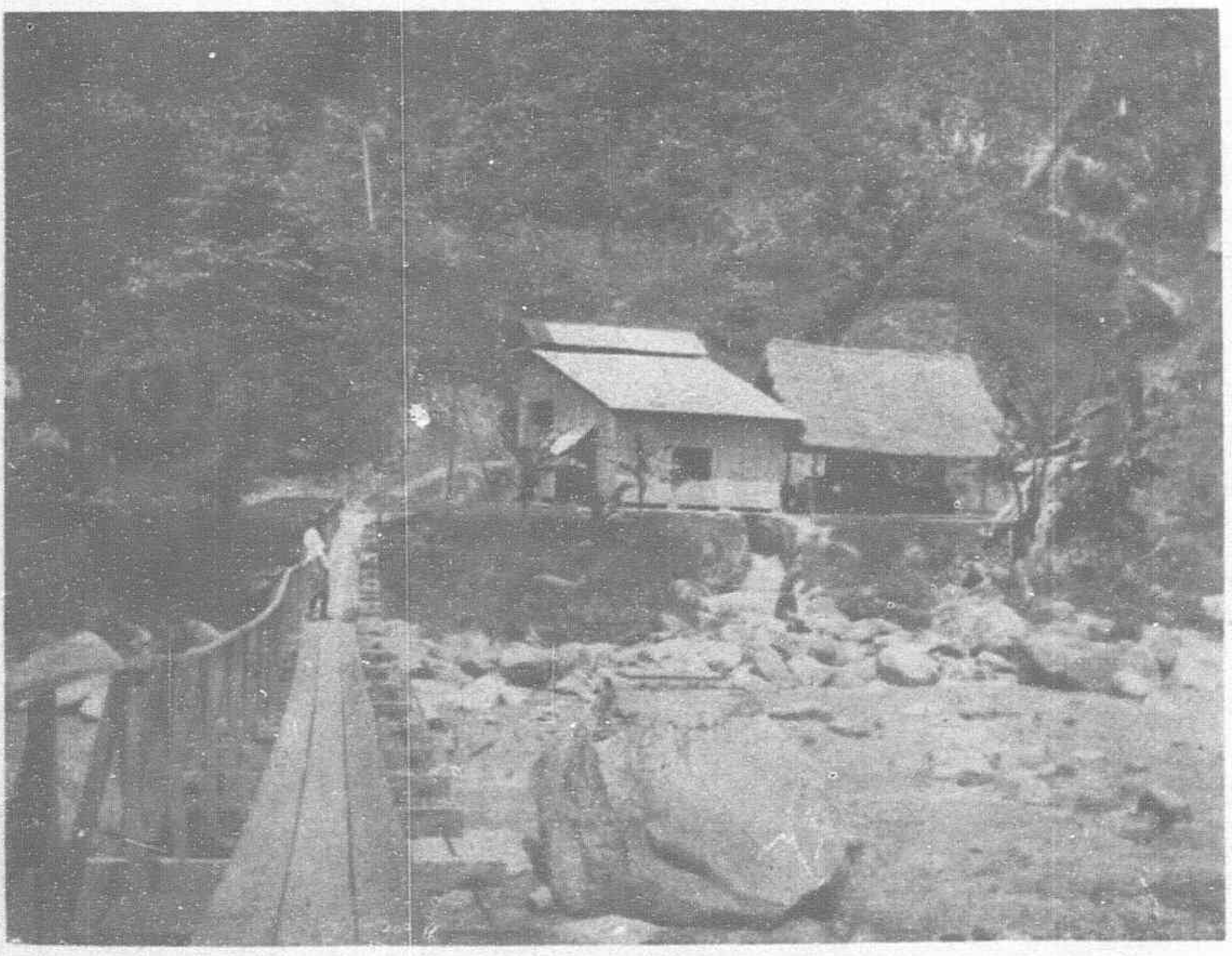
A rectangular gate sluice 6 ft. wide was originally fitted in the dam, and also two 15 inch scour pipes. The pipes were found to choke at every freshet, which would fill the whole pond with sand and gravel brought down from the mining operations, and so necessitate shutting down and hence cessation of digging, while the gate was raised and the intake pond cleared. The intake pond is no longer used as a settling basin for sand, and discharge of settled material no longer necessitates stoppage.

The water passes from the pond over a 15 foot sill in the skimming wall.

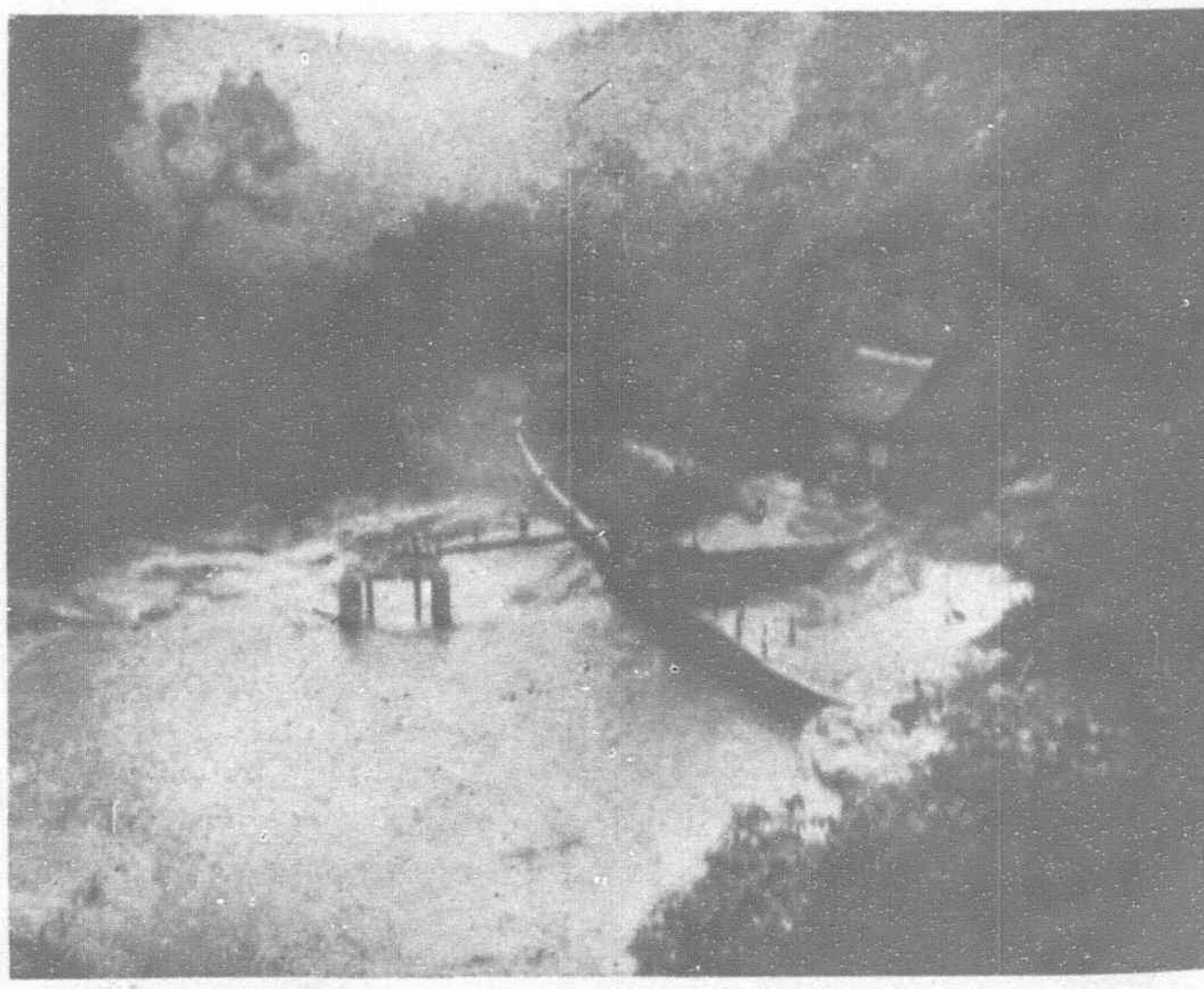
This sill is protected by a grid of iron bars at 6 inch intervals to prevent passage of logs or big timbers, and the following channel is fitted with a grid of 2 inch spaces to remove smaller floating debris before the water reaches the inlet chamber, which is of concrete and wood.

From this inlet a 36 inch diameter pipe 11 chains long conveys the water to the combined settling basin and pressure box.

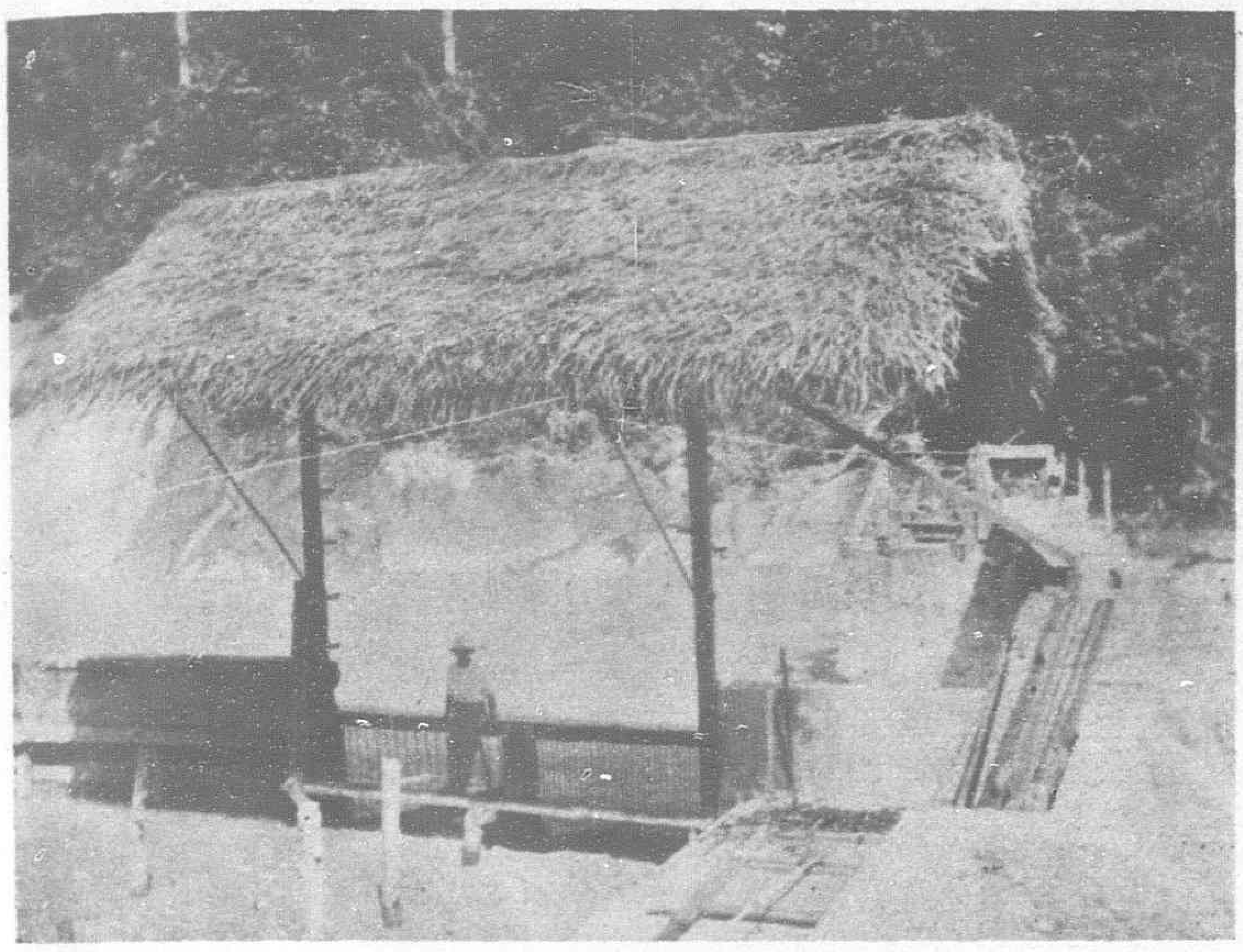
While passing through this pipe the water is deprived of most of its sand by means of 5 sand traps, located at suitable positions for discharging back to the river. Each trap consists of a funnel shaped iron casting with an opening 20 x 18 inches bolted to the under side of the pipe and terminating in a 4 inch spigot. Inside the pipe itself, and on the downstream side of each trap, is a baffle plate closing the lower half of the pipe. As a rule the spigots are kept



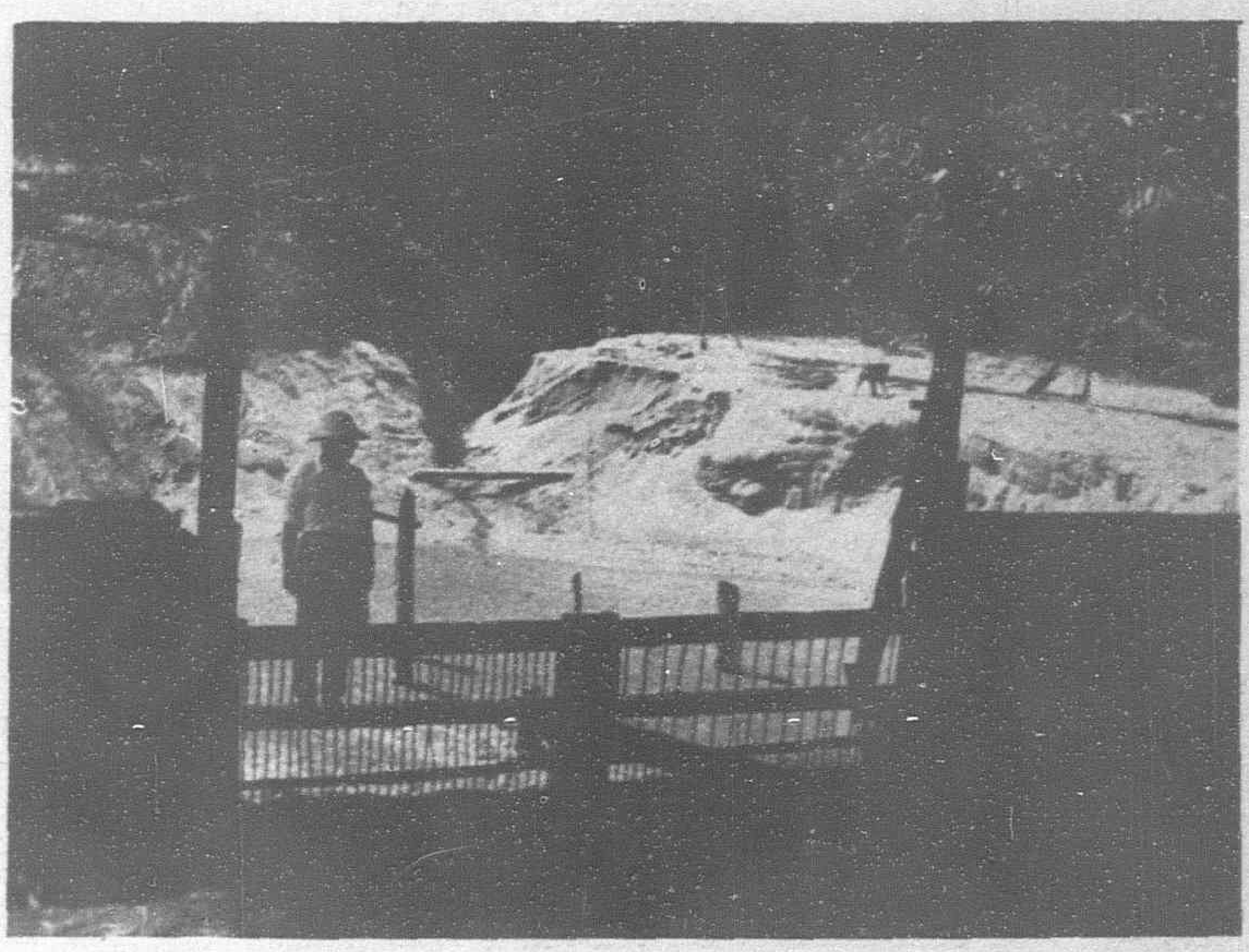
Power House



Intake: Looking from Above and Looking Down Stream



Spillway: Looking from Inside



Intake Spillway Looking from River Stream Side

open, but the last three are fitted with valves constructed from old pelton nozzle needles, so that in dry spells one, or two, can be closed to prevent shortage of water to the motor. These sand traps waste more water than that actually used for generation of power. They remove practically all the coarse sand, the solids eventually passing over the last baffle being only very fine sand, or slime, which goes on to the settling basin.

This basin is a reinforced concrete tank of 2,430 sq. feet superficial area and a depth of 11 feet. It is divided into two parts, by a skimming wall of concrete surmounted with timber to about 6 inches below normal water surface. On the inlet side there is also a wooden baffle wall, extending from above water level to about 2 feet from the tank bottom.

Incoming water from the 36 inch pipe has thus to pass under this baffle, before rising over the parting wall to the outlet side of the tank. The mouth of the 30 inch outlet pipe is again protected by a skimming box the top of which is about 6 inches below that of the parting wall.

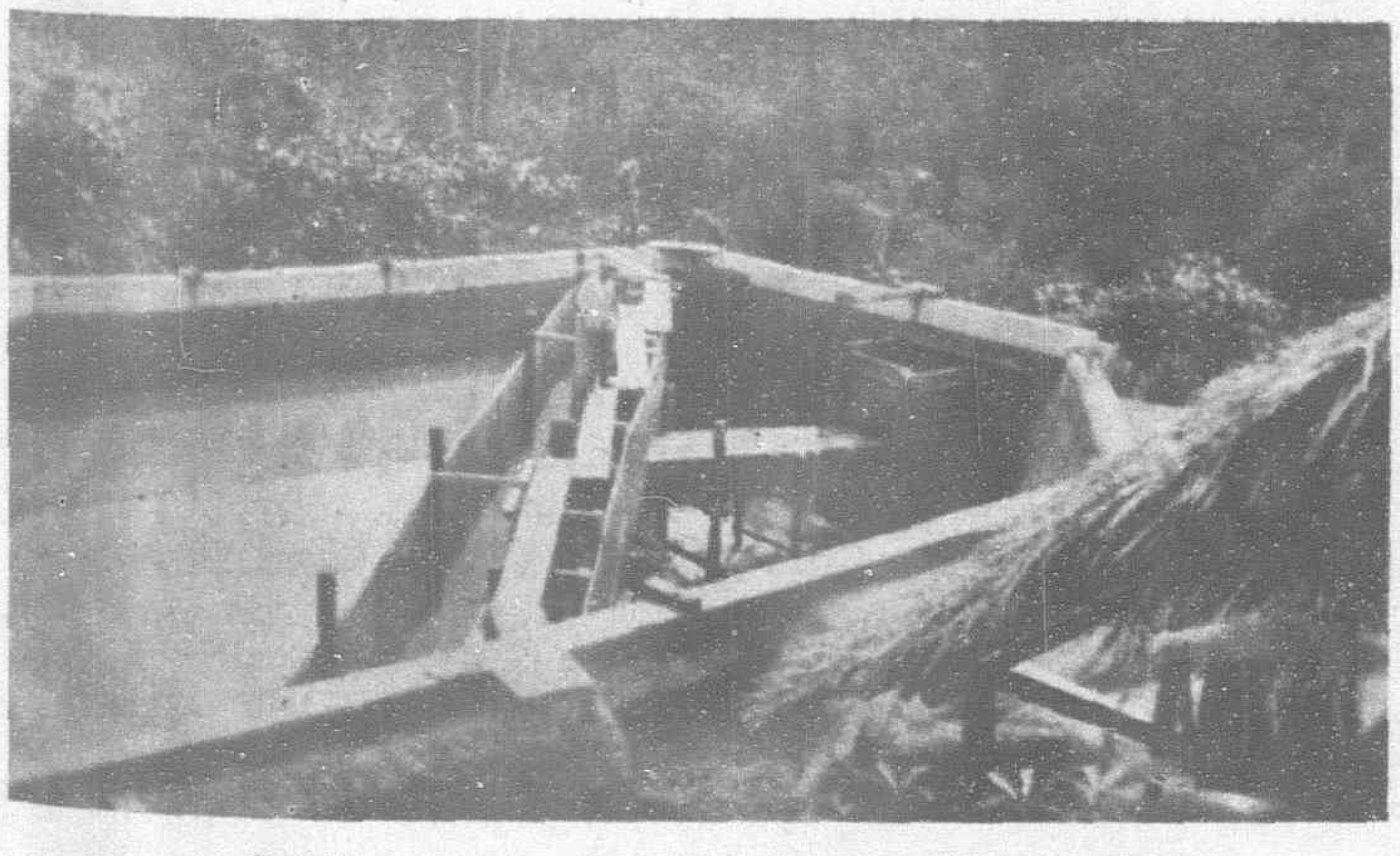
An overflow sill is provided on the inlet side of the tank each half of which is provided with scour valves through the walls. Under normal running conditions these are closed.

Settling Basin Pipe Line Entering Settling Basin Showing Bye-pass Pipe Leading to One Side of Basin for Purposes of Cleaning Out

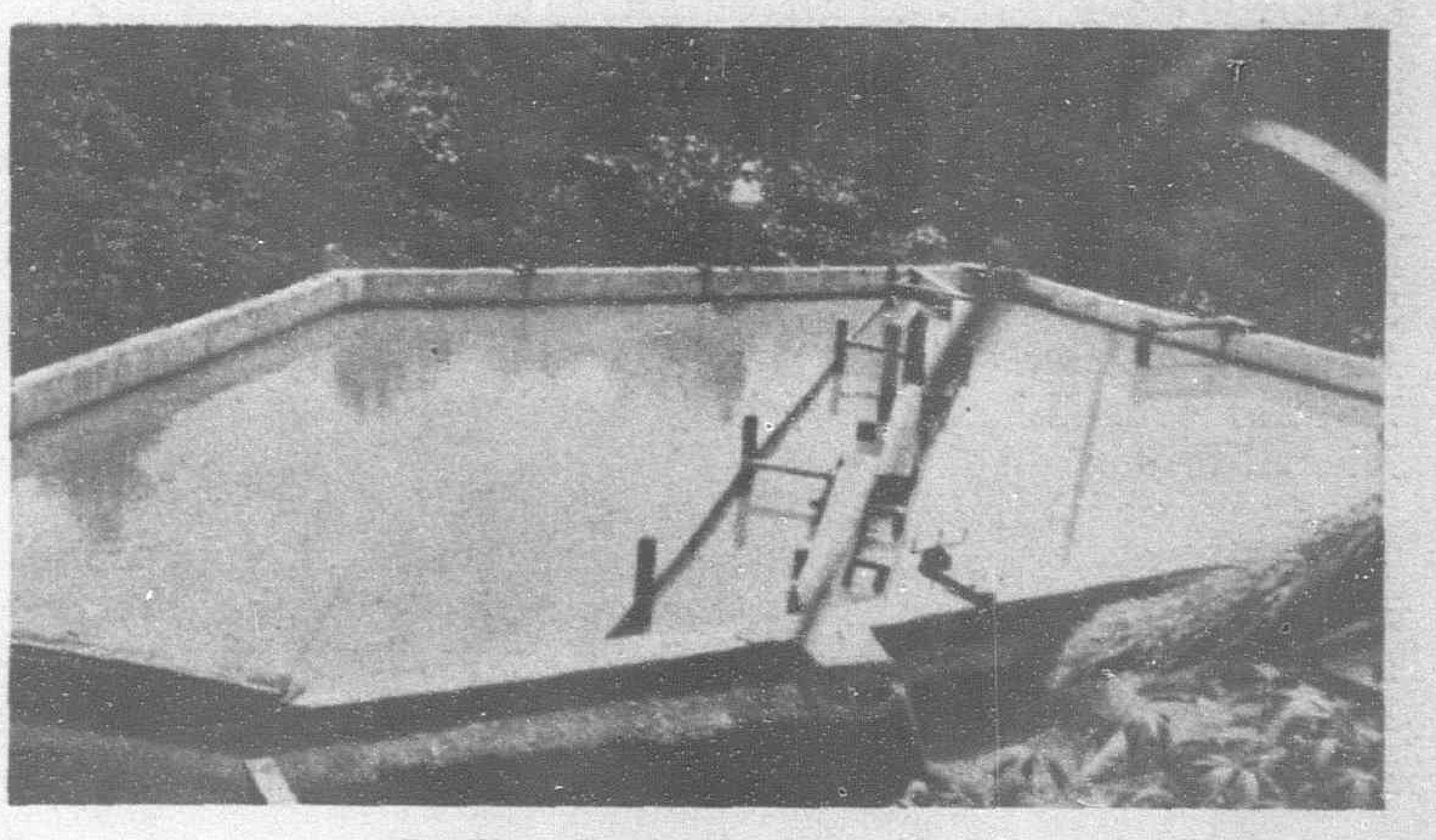
An 18 inch diameter by-pass pipe connects the 36 inch inlet pipe with the discharge side of the settling tank. Both pipes are fitted with valves, thus allowing admission direct to either half of the tank as required. Normally (about 21 out of every 24 hours) all water enters through the 36 inch pipe, flows under the wooden baffle, and over the skimming wall to the discharge side of tank. Here it has again to mount over the top of the protecting box before entering to the 30 inch outlet pipe. Practically all sand, that would cause trouble through cutting the nozzles, is thus removed from the water.

Every morning one side of the tank is cleared out, the operation taking 2 to 3 hours. When the inlet side is being cleared the main flow is by-passed through the 18 inch pipe direct to the outlet side of the tank. When the outlet side is being cleared, inlet water from the 36 inch pipe is regulated so that it rises about $\frac{2}{3}$ only up the skimming wall, and enters a flume running across the outlet side, direct to the protecting box of the outlet pipe. Entry to this flume is by a gate at the skimming wall, which is closed under ordinary running condition.

From the settling basin to the power house, a distance of 46 chains, the pipe consists of 11 chains of 32 inches diameter



Settling Basin One Side Being Cleaning Out



Settling Basin in Operation

and 35 chains of 30 inches diameter. The total fall is 460 feet and the effective head about 435 feet. The 36 inch and 32 inch pipe is all of $\frac{1}{8}$ inch plate: the 30 inch of $\frac{1}{8}$ increasing to $\frac{5}{16}$ inch for the bottom 20 chains. Longitudinal joints are all double lap rivetted, and circumferential joints single rivetted.

In the upper part, and wherever the grade is easy, the pipe is supported upon hard wood sleepers. A syphon is carried on wooden trestles with a concrete anchor block in the dip. 15 inch air vent pipes are provided above and below the syphon.

The bottom 20 chains are steep. Concrete pillars and anchor blocks are here used.

The line was designed for a maximum flow of 7 ft. per second under full power, but for that actually used the maximum velocity in the pipe barely exceeds 3 ft. per second.

The plates came from America ready punched. Some were rolled and rivetted in Kuala Lumpur and some at Bentong.

The installation is probably unique in respect of the amount of sand carried by the river at the head works, the matter in suspension there varying from about 2,000 to 8,000 grains per gallon depending upon the time of day, season of the year, and quantity of water in the river. As a rule mining dies down at night and the river becomes comparatively clear for a few hours. Solids in the Pelton wheel discharge are estimated daily, and the average over 12 months is 160 grains per gallon containing practically no cutting sand. There are 17 buckets in the wheel.

The first set had to be replaced at the end of 2 years, on account of the erosion resulting from sand in the water. The sand traps were later installed and the present set of buckets has been in use for 6 years, though they are now in bad condition and will soon have to be changed.

The Power House plant consists of one unit, a two nozzle single runner overhung Pelton wheel direct coupled to an 800K. watt C.E.C. alternator. The motor is furnished with needle valve hand regulation and governor-operated jet deflector. The new nozzles are 4$\frac{3}{4}$ inches in diameter. One nozzle only of the Pelton is in use.

The exciter dynamo is belt driven from the alternator shaft. The machine is provided with an extra heavy flywheel, to meet momentary current demands.

Three phase current is generated at 2,200 volts and 60 cycles and is stepped up for transmission to 11,000 volts by three single phase oil immersed air cooled transformers, delta connected, each transformer having a capacity of 333 K.V.A.

The switch panel contains one oil switch with automatic release, and the usual ammeter and voltmeters. A Tyrrill automatic voltage regulator is also fitted. This tends to maintain the transmission voltage by enhancing the exciting current, as temporary heavy demand reduces the speed of the generator.

The maximum output so far has not exceeded 320 Kilowatts and the usual load is considerably less. Protection at the Power House is by means of an aluminium cell type lightning arrester, surrounded with spark gap and charging device.

The transmission line from Power House to the sub-station on the main road about a mile from Bentong Town is 4.4 miles in length. It consists of 2.6 miles of three No. 4 wires arranged in a 3′ 9″ triangle and 1.8 miles of three No. 5 wires. The standards are of sawn hard wood, with H poles of extra large section, where the span exceeds the regulation 200 feet. The river span is 732 feet in length and consists of three No. 0 wires in a 7 foot triangle. The stretch of 1,060 feet across a corner of the Perting dump is divided in half by a 52 foot tower. Chengai posts have given far better service than those of Mirbau.

The 11,000 volt line reaches the sub-station by way of a set of disconnecting switches mounted on a platform fixed to a set of four terminal poles outside the building.

Within are two sets of single phase transformers, the larger of 150 K.V.A. working in parallel with the smaller of 50 K.V.A. These reduce the voltage to 2,200 at which pressure it is taken on board the dredge.

The transformers are protected, on the high tension side, by a lightning arrester of similar type to that in the power house.

The line from the sub-station crosses the Government road and then branches, one leg going to the dredge paddock, and the other to the machine shop and tin shed.

Connection between the overhead feeder line and the dredge is made by means of a three-core cable. The cores, insulated with vulcanized rubber, are laid together and wrapped over all with five layers of varnished cambric. This is then served with compounded jute, and armoured with galvanized iron wire.

On the dredge itself there are three small transformers which step down part of the power to 220 volts for use in the small motors and for lighting, but the greater part of the power is used at 2,200 volts, in the large main drive and pump motors.

There is a main oil switch on the dredge with automatic release, and each motor is provided with an automatic cut-out, if for any reason the motor should become overloaded.

A list of motors installed on the dredge is as follows :—

Main Drive motor capable of developing ..	150 h.p.	2,200 volts.
Main Screen Pump motor capable of developing	200 h.p.	
Table Pump motor capable of developing ..	50 h.p.	
Swing Winch motor capable of developing..	25 p.h.	220 volts.
Stacker Belt motor capable of developing ..	25 h.p.	
Screen motor capable of developing.. ..	25 h.p.	

The cost of the installation from intake dam to sub-station, including dam, pipe and accessory works, power station and equipment, transmission line and sub-station was about £15,000.

The work over a whole year (1918) may be summarized as follows :—

Total generated	1,310,000 K. Watts.
Total dredged	775,000 C. Yards.
Cost of power (includes labour and maintenance but no depreciation)	$22,712

Power costs :—2.9 cents per cu : yd. dredged
1.73 cents per elect : unit
1.69 elect : units per cu : yd.

Toho Electric Firm Moves Into Niigata

THE Toho Electric Power Company has extended its sphere of operation to Niigata Prefecture, the largest power consuming center after Tokyo, Osaka, Nagoya and Fukuoka prefectures. The Tokyo Electric Light Company recently filed an application with the Niigato Prefectural Government for a franchise to supply more than 50 horsepower. As it is found difficult for the company to get the franchise, the company intended to absorb the Niigata Electric Company which is carrying on the light and power supply business over Niigata City, Nishi-Kambara, Kita-Kambara and Minami-Kambara counties.

In precedence to the Tokyo Electric Light Company, the Toho Electric Power Company through the Toho Securities Holding Company has bought over a majority of the shares of the Niigata Electric Company, it is reported. Thus the Toho Power has acquired a preferential power to start activity in that prefecture.

The Niigata Electric is capitalized at Y18,400,000 of which Y.15,000,000 is paid up. The power generative capacity of the company is 13,000 k.w. for water and 5,000 k.w. for steam. The volume of supply of power is 10,000 horsepower and the number of lights 300,000.

In connection with the buying over of shares, the Toho Electric Power has caused the Niigata Electric to increase its authorized capitalization to Y.25,000,000 and out of 500,000 shares the Toho Securities will subscribe 266,000 shares.

These two companies are expected to hold their general meetings of shareholders on March 28 to submit the matter for the increase of capitalization and merger. The formal merger will take place on June 1. Two directors, including one managing-director, and one auditor will join the company from the Toho Power, it has been decided.

Since the Toho Power established the Toho Securities Holding Company a few years ago, more than 10 companies of similar nature have come into existence. All these companies are to control the affiliated corporations financially by holding securities and debentures.

Engineering Notes

ELECTRIC LIGHT, POWER AND TRACTION

S.M.R. ELECTRICAL SYSTEM.—Before the current fiscal year is over, the South Manchuria Railway Co. is going to build a new power house at Kuochiatien on the S.M.R. Main Line (north of Ssupingkai) and to buy up the power transmitting line between Dairen and Chinchou, owned by Kwantung Government, so as to unify the control of the Dairen-Pulantien Line.

Then, the Company proposes to enlarge the Amanogawa Power House on the Hoshigaura tram line and to undertake supply of electricity to New Wiju across the Yalu from the Antung side for which the agreement has already been concluded.

The Company's plan to unify the electricity system along the S.M.R. Lines is mapped out on a business-like basis and follows :—

Firstly, with Fushun for the base one line will branch out to Mukden, Anshan, and Haicheng, another to run between Mukden and Penchihu, and a third to branch out between Mukden and Tiehling.

Secondly, from the Antung base will run out the Antung-New Wiju line, as stated above, to be extended to the next station on the Chosen Railway. Another line will run from Antung to Penchihu on the Mukden-Antung Line.

Thirdly from the Changchun base will run out a southward line to Tiehling *via* Kungchuling, Kuochiatien, Ssupingkai, Changtu, and Kaiyuan.

Fourthly, from the Dairen base will run out the Dairen-Port Arthur Line and also the Dairen-Pulantien (already in existence) to be extended north to Haicheng.

Fifthly, from the Yingkou base will run out the Yingkou-Tashihchiao line.

JAPAN POWER CO. TO START ACTIVITY IN KOBE.—The Japan Electric Power Company is expected to display its activity in Kobe shortly, as arrangements for the supply of electric power to Kobe consumers, after long negotiations with the Kobe municipal authorities, have been concluded through the courtesy of Governor Cho, of Hyogo Prefecture.

According to the agreement, the Japan Power Company will not supply Kobe consumers directly, but will sell power to the Kobe Municipality, as the Ujigawa Electric Power Company is doing. The total volume to be supplied to Kobe city is limited to 10,610 kilowatts, at the same charge as the Ujigawa Power Company.

The power will be sent to the transforming station, which the Japan Power Company owns in Nikenjaya, to the Fukiai and Minatogawa transforming stations and to other stations which will be purchased by the Kobe Municipality. If the consumption of power increases in future, the Ujigawa Power will supply 60 per cent. for additional consumption and the remaining 40 per cent. will come from the Japan Power Company.

Although the terms of the contract are not yet made public, it is generally considered that it will be valid for five years. The selling price is also not yet announced publicly.

NEW 2,000 KILOWATT GENERATOR.—The Changchun Branch power house of the South Manchuria Electricity Co., Dairen, has a 2,400 kilowatt generator.

Owing to the steady growth of demand for light and power, the capacity of the existing generator has come to be fully taxed.

When the new transmitting lines between Changchun and Kungchuling, now under construction, gets ready, a supply will have to be distributed to not only Kungchuling, but also elsewhere on the same section.

The Company has decided to instal a new generator of 2,000 kilowatts, and has applied for Government permission.

FORMOSAN POWER COMPANIES.—The Taiwan Electric Power Company, Formosa, has decided to absorb the Taiwan Electric Development Company, capitalized at Y.6,000,000, of which Y. 4,449,500 is paid up, an organization under joint investment of the Bank of Taiwan and the electric powe company. The matter will be submitted to its general meeting of shareholders on April 20.

On the absorption the Taiwan Power will increase its capitalization from Y.30,000,000, of which Y.28,200,000 is paid up, to Y.34,449,500.

RAILWAYS

SOVIET RAILWAY IN TURKESTAN.—According to reports published in Russian papers, the Soviet Government has launched a big railroad construction program in districts bordering on Chinese Turkestan. Construction work was started in 1927 and arrangements are now being made for additional railways in that neighborhood, it is stated. Two new lines, one leading from Semipalatinsk to Yamantau, a city situated on the Russo-Chinese border, and another line from Semipalatinsk to Chelyabinsk, an important center still nearer to the Sinkiang boundary, were completed and opened for traffic on December 20, 1928. With the completion of these two railways Sinkiang is practically surrounded on both the northwest and the west by Soviet influence.—*Kuo Min News Agency.*

KWANGTUNG-YUNNAN RAILWAY.—In connection with the proposed Inter-provincial railway line connecting Kwangtung and Yunnan, the Ministry of Railways is dispatching a number of engineers to survey the entire section to be traversed by the line so as to facilitate its early construction. It is learned that the new line will link the districts of Pangpu, Hsienching, Nanhai, Samshui, Shiuning, Takhing and Fungchun in Kwangtung, with Tsangwu, Tengyun, Mongkong, Pingnan, Kweiping, Wunsuan, Laiping, Tsienkiang, Tu-an, Tungnan and Hsingyi in Kwangsi, and Loping, Shinonung and Luliang in Yunnan.

SURVEY ON NEW RAILWAY BEGUN.—Surveying of the routes of the proposed Kwangtung-Kiangsi and Kiangsi-Fukien Railways has started at the Nanchang end. The former line, according to the Ministry of Railways, will start from Nanchang, pass through Southern Kiangsi and terminate at Chaochow in Kwangtung to connect with the Canton-Hankow Line ; the latter will start from Foochow, pass through Shaowu and Sankwan in western Fukien, Eastern Kiangsi, and terminate at Nanchang to connect with the Nanchang-Kiukiang Line. In a telegram to General Chu Pei-teh, Chairman of the Kiangsi Provincial Government, Minister of Railways Sun Fo, requests that the surveyors despatched by the Ministry of Railways be given all necessary assistance to facilitate their work.

ELECTRIFICATION OF MAYURBHANJ.—The Maharajah Protap Bahadur Deo of Mayurbhanj State, in the province of Behar and Orissa, has marked his accession by electrifying his chief town, Baripada.

The General Electric Co. (India), Ltd., entrusted with the scheme, has equipped a power station with a 70-k.w. oil engine-driven generator, installed pumping sets, erected over eleven miles of overhead line, and wired the houses. The Governor of Behar and Orissa started up the plant early in January.

TOKAIDO LINE TO BE QUADRUPLE-TRACKED.—Excepting the stretch between Maebara, 68.8 miles east of Osaka, and Numazu, 85.6 miles west of Tokyo, the Tokaido line of the Government Railway, where the traffic is heaviest, will be quadruple-tracked by the end of the fiscal year 1937-38. The project calls for an outlay of Y.45,087,000.

The construction program :

1.—Section between Shinagawa and Tsurumi, will be completed during 1929. To cost Y.700,000.

2.—Section between Tsurumi and Hodogaya will also be completed during 1929. To cost Y.800,000.

3.—On the section between Hodogaya and Kozu, the work will commence during this year and will be completed by April, 1934. To cost Y.3,000,000.

4.—On the section between Kozu and Numazu, the work will commence during 1929 and will be completed by April, 1932. To cost Y.8,617,000.

5.—On the section between Kyoto and Maebara, the construction work will commence during 1931 and will be completed by April, 1938. To cost Y.26,180,000.

6.—On the section between Kyoto and Kobe, the work will commence during 1929 and will be completed by April, 1933. To cost Y.5,800,000.

Of the many sections above referred to, the first two—between Shinagawa (Tokyo) and Hodogaya (Yokohama)—are expected to be completed this coming autumn, and inasmuch as passengers and freight will be carried on separate tracks, traffic between these two cities will be handled with considerable efficiency, when the quadruple tracks are completed.

West of Yokohama, the work for doubling the present double tracks will be completed as far west as Hiratsuka during this year. The construction work is now going on between Hiratsuka and Numazu, between Kobe and Osaka, and Kyoto and Osaka.

On the long stretch between Numazu and Maebara, extending nearly 200 miles, the work of quadrupling the tracks will be started when the increase of traffic volume justifies the conversion.

In all probability, the entire stretch of the Tokaido line will be quadruple tracked by the end of 1939.

OSAKA-ISE RAPID ELECTRIC RAILWAY.—The construction of a rapid electric railway, which would connect Osaka and Ise (where there is the Ise Grand Shrine) in about 2.5 hours and Kyoto and Ise in about 3 hours, is making smooth progress, and there is a likelihood of this line being opened to business in about November, next year.

It was in April, last year, that the Sangu Denki Tetsudo K.K., started construction of the line between Sakurai and Uji-Yamada, a distance of 58.8 miles, connecting on its way Hase, Haibara, Inari, Nahari, Matsuzaka, etc. The Sangu is a sister company of the Osaka Electric Tramway Company.

Between Haibara and Matsuzaka, there is a tunnel which is 11,200 feet or about two miles long, but so far, the work has progressed more than one half, about 7,000 feet having been opened.

Upon completion of the line, electric trains consisting of six carriages will run every half hour on a 4.8 feet gauge track operated by 1,500 volts of power. Compared with the fact that the Government Railway at present takes from 5½ to 6 hours between Osaka and Uji-Yamada, the time required by this proposed new line will be shortened to more than one half. As for the passengers coming from the Kyoto district, they are to take the Nara Electric Railway as far as Yagi on the Osaka Electric Railway and change to the new line.

ARMSTRONG WHITWORTH.—It is announced that Sir W. G. Armstrong Whitworth & Co., Ltd., have received a contract from the Crown Agents for the Colonies for the construction of 12 Passenger Locomotives and Tenders of 5-ft. 6-in. gauge for tde Ceylon Government Railways.

These Locomotives will be constructed at the Scotswood Works at Newcastle-upon-Tyne.

INDUSTRIAL

G.E.C. CONTRACTS.—For South China two Portable Conveyors, also Belt Conveyors and Hoppers for Coal Mining, all of Fraser and Chalmers manufacture.

The contract was completed last year in Singapore for 14 High Speed Passenger Lifts installed in Government Buildings manufactured by the Express Lift Co., London.

The interests of the General Electric Co., Ltd. in China are in the hands of the General Electric Co. of China Ltd. Head Office in Shanghai and Branch Offices at Hongkong and Dairen.

General Electric Co., Ltd. have obtained the following contracts: For the Malay States, 100,000 k.w. Steam Turbo set to be manufactured at the G.E.C., Fraser & Chalmers' Works, at Erith.

KANEGAFUCHI BOSEKI K.K. (Kanegafuchi Spinning Co., Ltd.).—The company has decided to construct a new weaving mill at Nagahama, with a capacity of some 1,000 looms, at a cost estimated at Y.5,000,000. The new mill is to be devoted to silk textiles.

BIG S.M.R. ORDER FOR KRUPPS.—It is announced here that the South Manchurian Railway Co. has placed a contract with Krupps and affiliated works jointly, for material and machinery to be employed in the construction of rolling mills, costing £750,000.

The concerns mentioned include Krupps works at Essen, Krupps Gruson works, Magdeburg, Gruppsche Friedrich Alfred Huette at Rheinhausen, and the German machine company at Duisburg.—*United Press.*

NEW CEMENT FACTORIES.—The Onoda Portland Cement Manufacturing Company is planning to expand its manufacturing capacity by about 370,000 tons annually, and the company will establish three more factories in Mie Prefecture, and Bunkeigun, Keisho-Hokudo, Chosen.

It is tentatively scheduled that the Mie factory will be constructed at a cost of Y.5,000,000, which will produce about 170,000 tons yearly. The Okayama factory be erected at a cost of Y. 3,000,000, producing 100,000 tons per annum, while the Chosen factory requires about Y.3,000,000 for construction, and will yield about 100,000 tons a year.

BLASTING POWDER FACTORY AT FUSHUN.—The bulk of blasting powder required in Fushun Collieries has heretofore been procured from Antung, etc.

A new blasting powder factory is to be opened at Kuchengtzu, Fushun, the seat of the Open Cut Mine, from April. Black powder will be the chief article to be put out, but ammonium nitrate powder, too, will be manufactured. The total annual production will be about 3,000 kilogrammes.

S.M.R. BUYS OIL REFINERY AT TOKUYAMA.—Following the purchase of land from Mr. Fusanosuke Kuhara in Shimomatsu Machi, Ohana Mura and Suetake Minami Mura in Tsuno Gun, Yamaguchi Prefecture, the South Manchuria Railway Co., Ltd., has just signed a contract for the purchase of an oil refinery of Asahi Sekiyu K.K. (Asahi Petroleum Co., Ltd.) located at Oshima, in Ohana Mura, in the Bay of Tokuyama. The transaction was made at Y.1,000,000. The S.M.R. Company is to manufacture parafine and wax at this works, besides using it as a base for supplying fuel to the Navy.

CHUO BOSHOKU K.K. (Chuo Spinning and Weaving Co., Ltd.).—A new spinning company is being promoted by Toyo Menka K.K. (Mitsui interests) and Toyoda Boshoku K.K. with a capitalization of Y.1,000,000. Capital of the new company will be increased to Y.10,000,000 immediately on establishment.

ELECTRICAL EXTENSIONS AT THE MINT, CALCUTTA.—For economic reasons, the authorities of H.M.'s Mint, Calcutta, recently decided to change over from their own power house and take supply from the Calcutta Electric Supply Corporation. To effect this conversion, the General Electric Co., Ltd., who, in 1906, put in the original installation, have installed sub-station plant, consisting of high tension truck cubicles, transformers, rotary converters and d.c. slate switchboard with inter-connecting cablework.

SHOWA DENKYU K.K. (Showa Electric Globe Co., Ltd.).—The Sampei K.K. of Osaka has established a new company known as Showa Denkyu K.K. to take over its electric lamp department. Another company is to be established to take over the metal department, to be known as Sampei Kinzoku Kogyo K.K. (Sampei Metal Industry Co., Ltd.).

YAWATA WORKS MARKED INCREASE OF OUTPUT.—The steel manufacturing industry of Japan was very satisfactory during 1928, and in consequence of this the import of foreign steel showed a marked decline.

According to the Yawata Iron Works, the supply of steel during 1928 in Japan was 2,305,807 tons, of which only 761,618 tons were supplied by foreign countries and the remaining 1,544,189 tons were produced from the steel works in Japan. The combined supply was larger by 234,559 tons than that of the preceding year. The production in Japan showed an increase of 238,661 tons, while the imports decreased by 4,102 tons.

The Yawata Iron Works reports that their plant produced much more steel rod in 1928, which checked the increasing trend of import of that article. The import of steel rod in 1928 was less by 66,563 tons than the preceding year. The production of mild round bar at the Yawata Works in 1928 showed an enormous increase of 87,244 tons over the figure in the previous year. Such activity in the manufacturing of mild round bar steel threw the market into confusion for a while and artificial measures for regulation of production of mild round bar steel had been considered among the manufacturers. The steel plate manufacturing industry also showed unparalleled activity in 1928, during which the production registered an increase of 66,437 tons. The recent ascendency of the shipbuilding industry in Japan is considered to be responsible for the steady appreciation of production of steel plate. As to rail production, it is reported that the total figure of consumption in 1928 fell to only half that of the preceding year, but, at the same time, the import of rail dropped by nearly 50 per cent.

However, the import of steel wire was still on the way to increase as a result of keen demand for nails and rivets. The import of steel wire gained by 63,558 tons over the figure in 1927. The manufacturing of steel wire was yet inactive. The Yawata Iron Works is delighted with such favorable results in steel manufacturing industry in 1928, and the works believes that all the steel markets in the Far East will become customers of Japan not before long.

SHIPPING

O.S.K.'S 4 BIG SHIPS TO BE BUILT AT MITSUBISHI.—An order for construction of four cargo boats of the Osaka Shosen Kaisha, which will be placed on its New York route has been placed with the Nagasaki yard of the Mitsubishi Dockyard Company, after inviting competitive tenders.

The deadweight tonnage of each new vessel will be 10,000 tons, and they will have a speed of 17 knots an hour, equipped with Sulzer Diesel engine. One of the four will be completed by the end of June next year, and the remainder within the course of next year.

JAPANESE-BUILT VICKERS ENGINES.—The largest Vickers-type engines constructed in Japan for mercantile work are installed in the motor vessels *Sumire Maru* and *Midori Maru*, which have recently been completed by the Mitsubishi Zosen Kaisha, for the Osaka Shosen Kaisha. The engines were constructed at the Kobe Yard of the Mitsubishi Company.

On the trials of one of the ships carried out recently, at full power, a speed of 13.86 knots was attained with the engines running at an average of 210 r.p.m. and developing 894 b.h.p. or 1,003 i.h.p. The mean effective pressure (average of two engines) was 6.72 kg. per sq.cm. or 96 lb. per sq. in.

With the ship loaded and the engines overloaded, a speed of 15.88 knots was attained with the engines turning at 229.2 r.p.m., the average power being 1,141 s.h.p. per engine or 1,373 i.h.p., the mean effective pressure being 7.66 kg. per sq.cm.

N.Y.K. AND CUNARD LINE.—The N.Y.K. and the Cunard Line have concluded an agreement, whereby the Nippon Yusen Kaisha will represent the Cunard Steamship Co. in the Far East as its general passenger agents, and the Cunard Steamship Co. will similarly represent the N.Y.K. in America and Europe.

This arrangement was discussed in New York and England, when Mr. N. Ohtani, the Managing Director of the N.Y.K., made a round-the-world trip last year, accompanied by Mr. Y. Nagashima, Manager of the Passenger Department of the Tokyo Head Office.

The N.Y.K., with its fleet of 150 vessels of 886,000 gross tons, operates services on almost all the principal ocean trade routes, except between the east coast of the United States and Europe, where the Cunard Line maintains its splendid trans-Atlantic passenger service. Hence, the alliance of these two great, world-renowned steamship companies will significantly enbance the facility of the passenger traffic across the Pacific and Atlantic Oceans.

DOLLARS IN PHILIPPINES.—G. A. Harrell, passenger agent in Manila of the Dollar Steamship Lines, announced recently that contracts have been let for the construction of two new vessels for the Dollar Steamship Lines to be placed in the Philippine inter-island trade. These vessels are now being built in Hongkong and will be completed in January, 1930.

Specifications provide that the vessels will be of about 3,200 tons gross, 312 feet long, beam of 51 feet, and will have a maximum draft of 15 feet. The ships will carry 2,500 tons of general cargo and have space for 100 tons of refrigeration cargo. They will have four hatchs and side ports for the quick working of cargo.

They will be equipped to carry 74 first-class passengers and 401 deck or steerage passengers. There will be one *suite de-lux* and 17 of the first-class cabins will be equipped with private baths. All first-class cabins are to be equipped with two Simon's beds and a couch suitable for a third person. On the upper deck there will be six sets of adjoining cabins with bath between, suitable for families. The cabins will be ventilated by forced air.

American fruits and vegetables *ex* the trans-pacific Dollar vessel will be served on the tables.

The present scale of inter-island fares will be maintained.

The vessels will run on 16-knot schedules, but are capable of making 18 knots. The two ships will alternate their routes. One will be routed Manila, Cebu, Zamboanga, Iloilo, Manila, and the other Manila, Iloilo, Zamboanga, Cebu, Manila. The schedules calls for a four and one-half days round-trip—Manila to Manila.

Daylight arrivals and daylight sailings are scheduled for each port, with a minimum of six hours in each port.

In Manila the ships will berth at Pier 7.

The captains, first officers, chief engineers, stewards and pursers will be Americans.

PUBLIC WORKS

TEN MILLION GALLON FILTER FOR CANTON WATERWORKS.—Messrs. the Jardine Engineering Corporation, Ltd., has been awarded a contract to supply the municipality of Canton with a Peterson rapid filtration plant capable of dealing with 10,000,000 gallons of water a day. The complete equipment will cost $225,000.—*Reuter.*

ELECTRIFICATION IN INDIA.—A contract was recently obtained by the General Electric Co. (India), Ltd., for plant and apparatus controlling the water supply ot Benares. Two high-tension vertical spindle slipring motors of a total output of about 700 b.h.p. are being supplied to the Bhadaini Pumping Station, which pumps water from the Ganges to the filtering station, and at Bhelupura four high-tension slipring motors, with horizontal shafts and having an aggregate output of 1,000 b.h.p., will be installed for driving the pumps delivering filtered water to the City. The motors and switchgear are now being erected, and will be put into commission at an early date.

FOUR ADDITIONAL FILTERS FOR FUSHUN WATERWORKS.—The Fushun Collieries Waterworks Office is going to instal four more filters on the turn of the month at the cost of Y.140,000.

At present, there are eight filters, the storage capacity of the reservoir being 19,200 tons. The existing waterworks were constructed in 1925. As the Colliery Town developed and its population increased, not to mention the wants of various industrial plants, the water consumption increased remarkably, and last summer, temporary suspension of water supply was necessitated on occasion, much to the inhabitants' inconveniences.

The additional four filters will raise the storage capacity up to 28,000 tons, and effort will be made to get the work finished by next summer, so as to deliver the residents from another possible water famine.

Then, two filters may always be held in reserve, and the cleaning of the filters be carried on from time to time by pressing the spare filters into service.

MORE EQUIPMENT FOR CANTON WATERWORKS.—Contract has just been signed between the authorities of the Waterworks and Carlowitz & Co. for the purchase of additional pumping plant to augment the capacity of the works. The new equipment is to be installed within one yezr of the confirmation of order by the manufacturers, and when completed, the waterworks will be able to furnish an additional fifteen million gallons of water per day. The equipment consists of multi-stage centrifugal pumps direct coupled to electric motors. Power is to be furnished by a separate power plant, also included in the contract.

The value of the contract is in the region of a quarter of a million dollars, and we understand that Mr. G. Y. Fong was responsible for the negotiation of the deal.

TELEPHONE, TELEGRAPH AND RADIO

DIRECT SHANGHAI-NANKING LONG DISTANCE TELEPHONE.—Installation of an addition direct Shanghai-Nanking Long Distance Telephone Line is nearing completion, service on the new line being now available between Nanking and Chinkiang, and Shanghai and Changchow. The authorities hope that the new line will increase telephone facilities between Nanking and Shanghai.

RADIO EMBARGO.—The embargo on radio and wireless accessories is lifted. In an order to the Commissioner of Customs at Shanghai, the Inspectorate-General of Customs states that henceforth importation of wireless parts and materials for making wireless apparatus is no longer prohibited. No special permit will be necessary for the importation of such merchandise which will be cleared upon payment of the regular import tariff duty.—*Kuo Min.*

NEW RADIO STATION FOR NANKING.—A powerful short wave radio station will be erected immediately in the Capital for broadcasting press messages, according to an announcement issued by the National Reconstruction Committee.

SOUTH CHINA CONTRACTS.—Amongst recent orders of interest taken in China and the East by the General Electric Co., Ltd., Magnet House, London, are the following :—

Contract from the Hongkong Telephone Co., for 5,500 Automatic Desk and Wall Telephones, also a large number of Central Battery and Line Switchboards.

These materials will be manufactured at the G.E.C. Telephone Works, Coventry.

For South China a repeat order for Underground Paper Insulated Lead-covered and Armored Telephone Cable to be manufactured at the G.E.C., Cable Works Southampton.

NEW Y.5,000,000 WIRELESS STATION—The Y5,.000,000 wireless transmitting station of the Japan Wireless Telegraph Company, recently built in Karitani, Hekikai-gun, Aichi Prefecture, was opened on April 18.

At first the station will transmit radio messages to Germany, France and Poland; but in near future various stations in England, Italy and other countries in Europe will be included in its sphere of business.

The station is provided with a long-wave transmitting apparatus manufactured by the Telefonken Company of Germany, which is believed to be the best and most efficient of the kind in the world.

Besides the above-mentioned apparatus the station has three short-wave sets of the tube type, of about ten kilowatts, capable of communicating with the three stations in Europe mentioned above with the wave-lengths of 38, 24 and 18 metres. They are to be used for emergency purposes and during the wet season in summer.

By the end of this year the power of these short-wave sets will be increased to 20 kilowatts so that communications can be made simultaneously with other stations.

The work of constructing the station was started in May of 1927 and was completed in January of this year. According to experiments made with the Nauen Station in Germany and a station in France on Feburary 5, it needed only 15 minutes to transmit a message.

At present wireless messages are being sent to Europe by the so-called relay method *via* Shanghai, Hongkong and Singapore, utilizing cables. It takes at least two hours for a wireless message to reach Europe by this route.

ROADS

TSINING-KAIFENG MOTOR HIGHWAY COMPLETED.—The extension route, from Tsining to Kaifeng of the Tsining-Chaochow Highway has been completed. This highway constitutes a direct route connecting the two provinces of Shantung and Honan.

HIGHWAY PROJECTS FOR HAINAN.—General Chan Ming-shu, Rehabilitation Commissioner for the Southern Region, is considering an ambitious plan for constructing a main highway practically forming a circuit around the island of Hainan. Such a highway will greatly facilitate the industrial development of the island as well as lessen the difficulties of reconstruction work.

The highway will cover over 2,000 *li*, will take four years to build, and is expected to cost over a milion dollars. It will pass through the districts of Wanning, Yaiyun, Kanem, Wancheung, Tanchow, and Linko and will thus afford access to the greater part of the island.

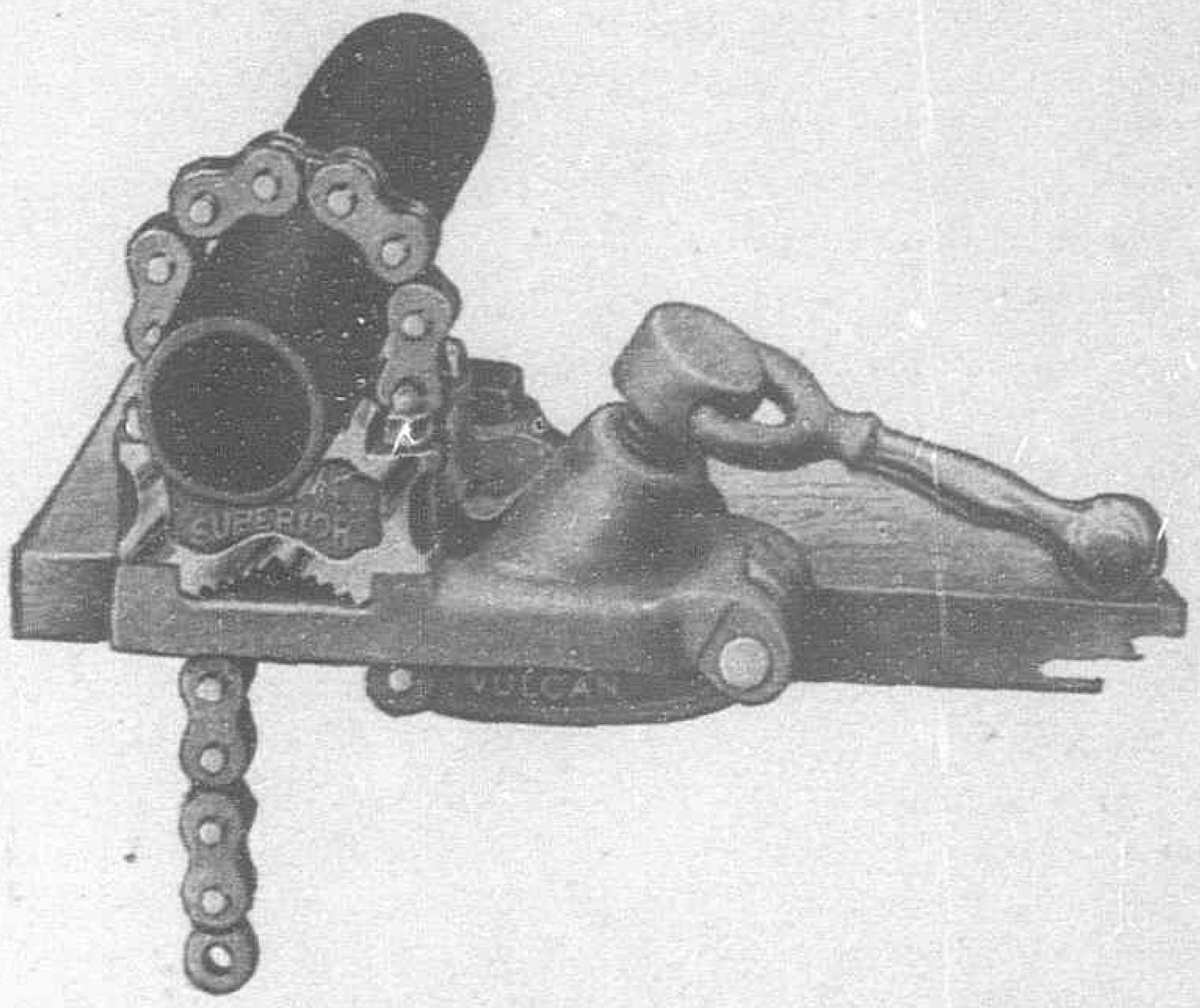
To meet the cost of constructing this road it is proposed to charge special fees for automobile licences in the island while the 20 per cent. surtax will also be appropriated for this purpose. The Bureau of Public Highways will have the responsibility of collecting these fees and surtax. Taxes at present applying to automobiles will be cancelled when the new scale comes into force.

The new scale of licence fees as follows :—

1. Public transportation autos, operating under monopoly, to pay a fee of $20 per month.
2. Private business cars, to pay $40 per month.
3. Private cars, not for business purposes, to pay $10 per month.
4. Motor-cycles, to pay $1 per month.

MACHINERY

WILLIAMS' NEW CHAIN PIPE VISE.—The NEW "Vulcan Superior" Vise recently placed upon the market by J. H. Williams & Co. Buffalo, N. Y. offers two outstanding advantages —1. "Overhead" Adjustment—the handle is ON TOP where it's easy to operate, and 2. Reversible Jaws for longer life—when the teeth first in use wear simply unscrew the bolts end turn the jaws over.



In addition, the makers state, each "Vulcan Superior" is of greater capacity, taking pipe 1/2-in. larger than other chain pipe vises of similar size.

Wholly made from tough wrought steel—no castings are tolerated. DROP-FORGED base, jaws, handle and chain-arm. The chains are of the same unsurpassed quality as those of the widely established "Vulcan" Chain Pipe Tongs. Unbreakable, compact, rapid in action, positive in grip. Fully Guaranteed.

Attractively finished in Chrome-plate and furnished in two sizes for 1/8 to 4½-in. pipe. Literature will be supplied by J. H. WILLIAMS & Co. on request.

AVIATION

CHINESE MONOPLANE.—Mr. Mei Lung-an, an engineer in the Kwangtung aviation bureau, has succeeded in making a small monoplane himself, according to Canton advices.

NATIONAL GOVERNMENT BUILT PLANE.—The first airplane to be constructed by the National Government at the factory recently established at the Hungjao airdrome at Shanghai and possibly the first airplane ever constructed in China, has just been completed and has successfully made a trial flight. The plane is named the "Success No. 1" and is modeled on the French Candron plane and is equipped with a French Hispano-Suiza 180-H.P. motor. It has a wingspan of about thirty feet and is about 25 feet long. The timber from which the frame-work was constructed was imported from the United States. It was constructed entirely at the Hungjao airdrome under the supervision of Col. Shen Teh-hsieh, who has under his direction some 31 staff members and about 100 workmen. The "Success No. 1" has a carrying capacity of 1,000 pounds and a speed of about 70-miles per hour and is said to be capable of reaching an altitude of 15,000 feet.

NANKING AUTHORIZES AVIATION COMPANY.—At a meeting of the State Council to-day, a resolution was passed authorizing the formation of the China National Aviation Corporation for the purpose of operating and developing commercial aviation and air mail service in China.

It will be a Government enterprise with a capital of $10,000,000 and headquarters at Nanking. Mr. Sun Fo, Minister of Railways, was appointed president of the corporation.

The corporation plans to operate passenger, mail and freight service and to develop all kinds of commercial aviation enterprises. Air routes will be designated by the Government. An air mail service between Nanking and Shanghai, Nanking and Hankow, and Nanking and Canton will be established at an early date.—*Kuo Min.*

CHINA'S FIRST AIR MAIL, PASSENGER LINES WILL OPEN WITHIN 6 MONTHS.—A contract was signed in Nanking on April 19, by Minister Sun Fo as President of the newly organized China National Aviation Corporation with the Aviation Exploration, Inc., under which the latter, an American company, agrees to carry the air mail for the Chinese National Government on three important lines. These are the lines from Canton to Hankow, Hankow to Shanghai *via* Nanking, and Nanking to Peiping.

The service is to be inaugurated within six months and it is hoped soon to extend the service to additional lines. The most modern aviation equipment and skilled aviators from the United States are to be used.

Training schools are to be established at once for training Chinese aviators and other personnel with the idea of employing them as soon as they are available. American pilots will begin the lines, it is understood, however.

The American side of the negotiations were handled by Major William B. Robertson, President of the Curtiss-Robertson Company of St. Louis, Missouri, and Commander Roland Riggs, legal representative of Mr. C. M. Keys, head of the Curtiss organization.

The linking up of the Curtiss interests with the first Chinese Government air mail and passenger lines is regarded as of high interest as far as the success of the venture is concerned.

The Aviation Exploration organization, it is explained, is a subsidiary of the Curtiss group of companies, the largest combination of aviation interests in America, according to their representatives here. The China National Aviation Corporation is a Chinese Government organization recently authorized by the State Council at Nanking to have a capitalization of $10,000,000.

It is estimated at least 20 airplanes will be needed on the proposd lines, these to come from the Curtiss organization at once, together with pilots. Two pilots accompanied Major Robertson's party to China some weeks ago. They are Mr. E. L. Sloniger and Mr. A. L. Caperton.

SIAM'S DUTCH AIR SERVICE.—Siam's Post and Telegraph Department has arranged with the postal administrations of the Netherlands and the Netherland East Indies for carrying air mail between Singapore and Java in connection with the five mail-carrying planes that recently initiated flights from Amsterdam. All countries *en route* were allowed to dispatch mails *via* these planes as a trial of the proposed service. No parcels were accepted and all postage was to be prepaid.

HONGKONG-SHANGHAI SERVICE.—A project for a Hongkong-Shanghai weekly air service is under consideration. It is reported that the latest type of De Haviland seaplane will be used, carrying six to eight passengers, and that it will be possible to make the journey in one day, which compares with three days by steamer. It is also proposed to extend this service to Canton and Macao if negotiators with the authorities concerned procure their sanction.

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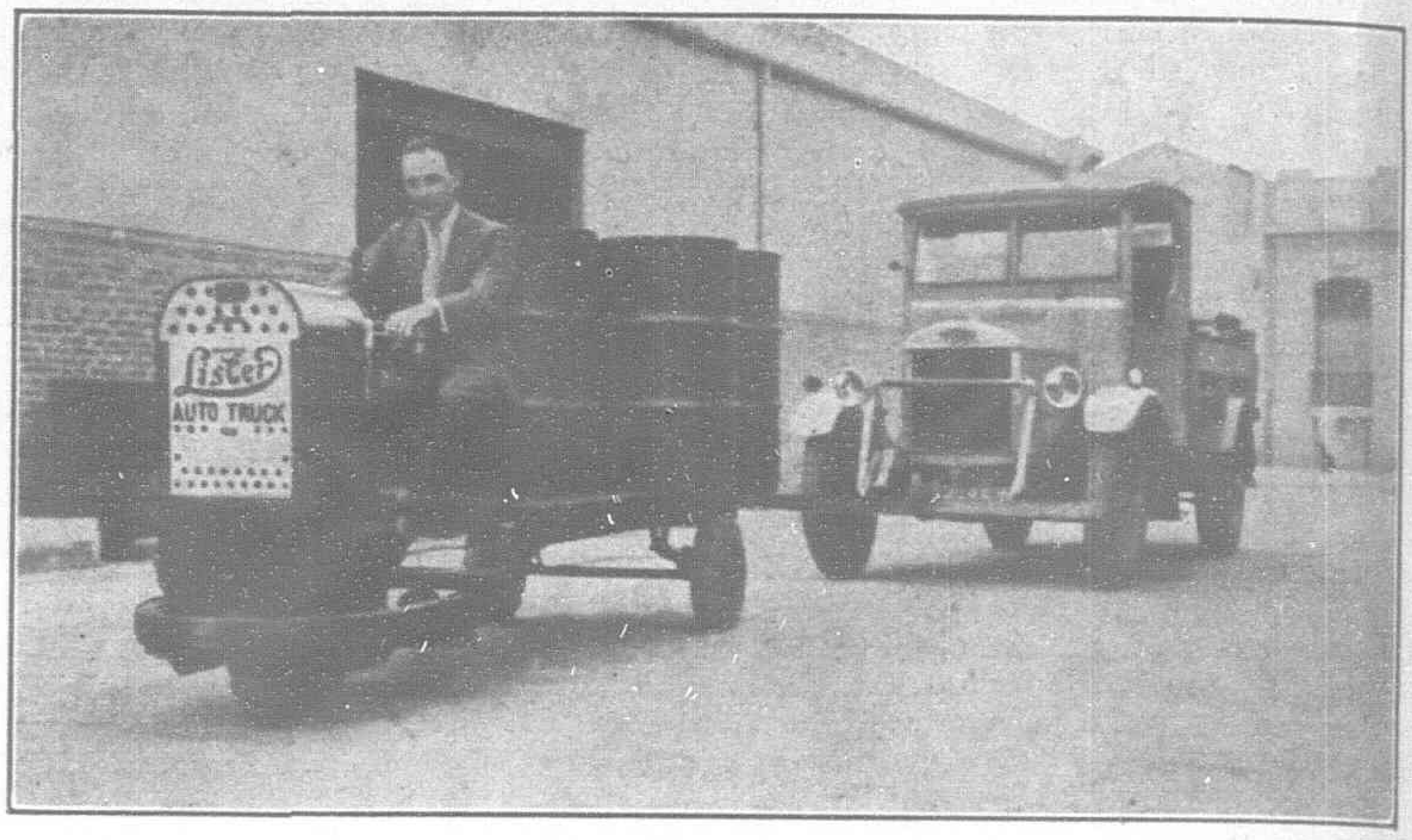

An AUTO-TRUCK drawing a load of over ONE TON ...and a lorry... up a gradient

To test the abilities of the Lister Auto-Truck, the Anglo-Mexican Oil Co., of Buenos Aires loaded an Auto-Truck with over one ton of "Mexfelt" Road Material, and roping the truck to one of their Tank lorries, set it to haul the load up a slow gradient. The test was carried out to the Company's entire approval, and to record it the above photograph was taken. This Auto-Truck's subsequent performance has so satisfied our Clients that they have recently cabled for a further three.

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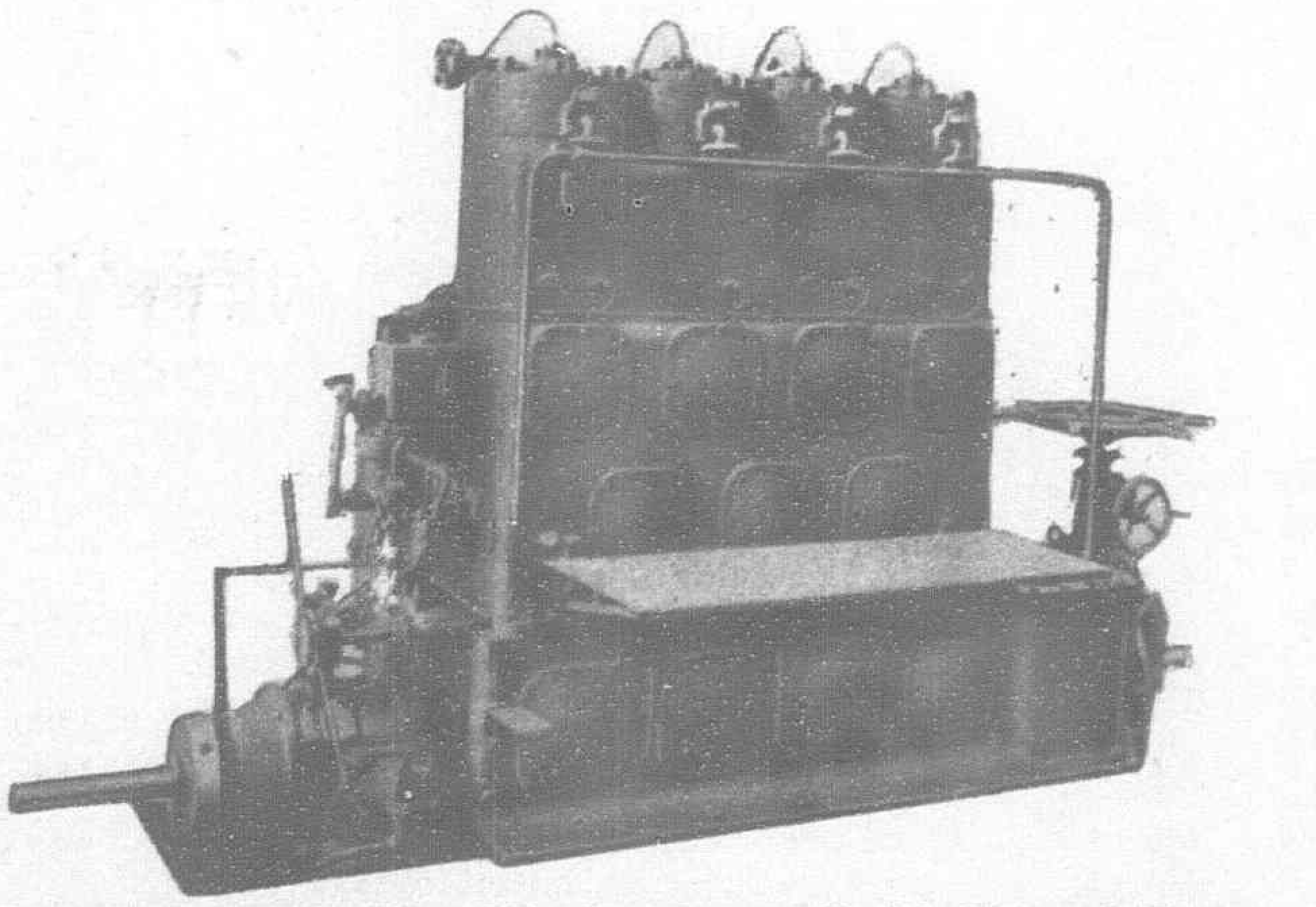

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